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Akita et al.

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(54) **HEAD CLEANING DEVICE, IMAGE FORMING DEVICE, AND HEAD CLEANING METHOD OF IMAGE FORMING DEVICE**

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(73) Assignee: **KONICA MINOLTA, INC.**, Tokyo (JP)

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B41J 2/165 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/16535*** (2013.01); ***B41J 2/16552*** (2013.01)

(58) **Field of Classification Search**
CPC B41J 2/16535; B41J 2/16552
See application file for complete search history.

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(57) **ABSTRACT**

A head cleaning device includes: a porous cleaning roller that rotates around a cylindrical axis while a cylindrical side circumferential surface is in pressure contact with a nozzle surface of an ink head to clean the nozzle surface; a storage tank that immerses a lower part of the cleaning roller in a cleaning liquid stored therein; a unit moving mechanism that moves a cleaning unit including the storage tank and the cleaning roller in a direction perpendicular to the axis of the cleaning roller; a hardware processor that controls a rotation speed [vr] of the cleaning roller and a moving speed [vx] of the storage tank and the cleaning unit; and a composition acquisition part that acquires a change in composition of the cleaning liquid in the storage tank due to mixing of ink supplied from the nozzle surface through the cleaning roller.

12 Claims, 11 Drawing Sheets

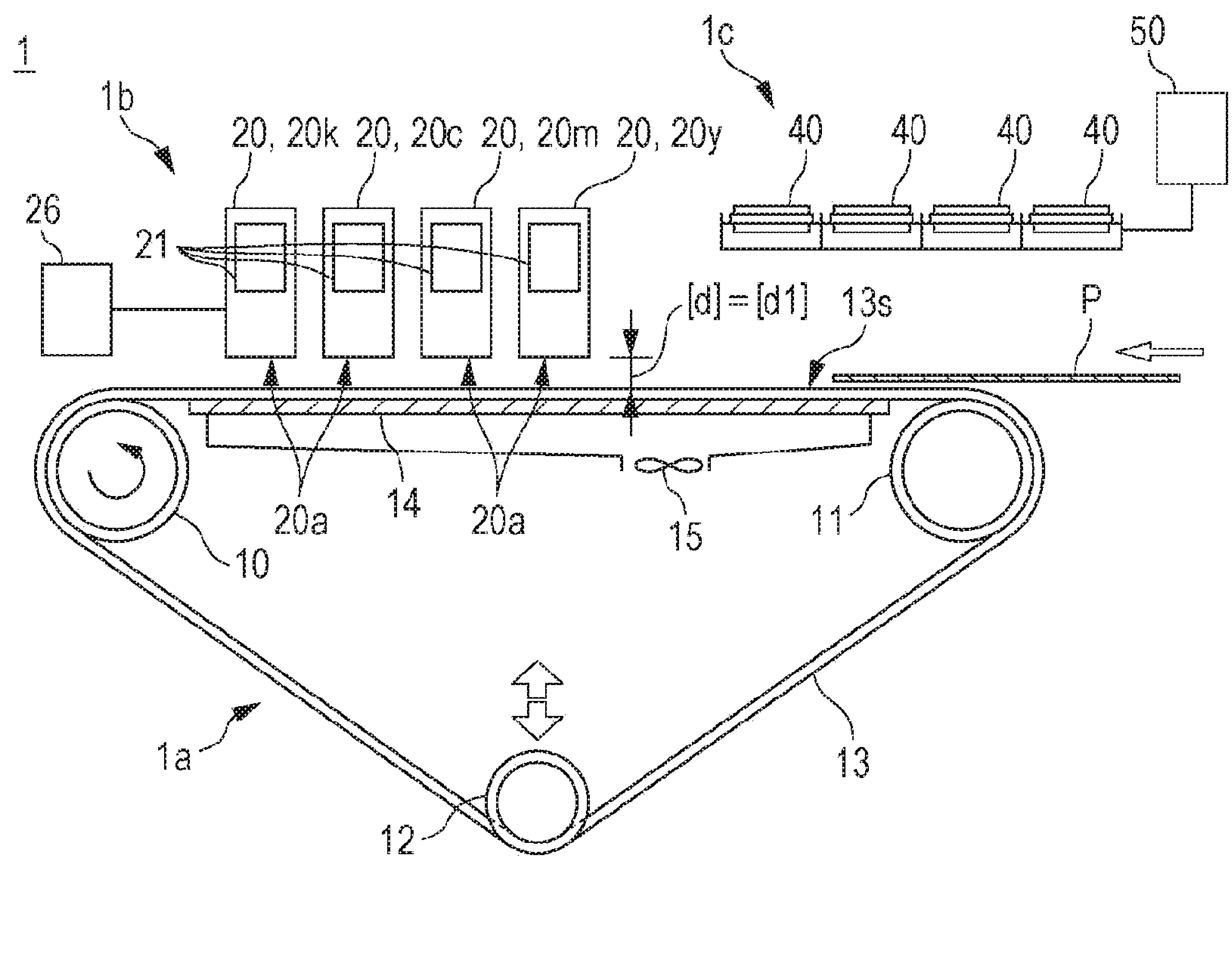


FIG. 1

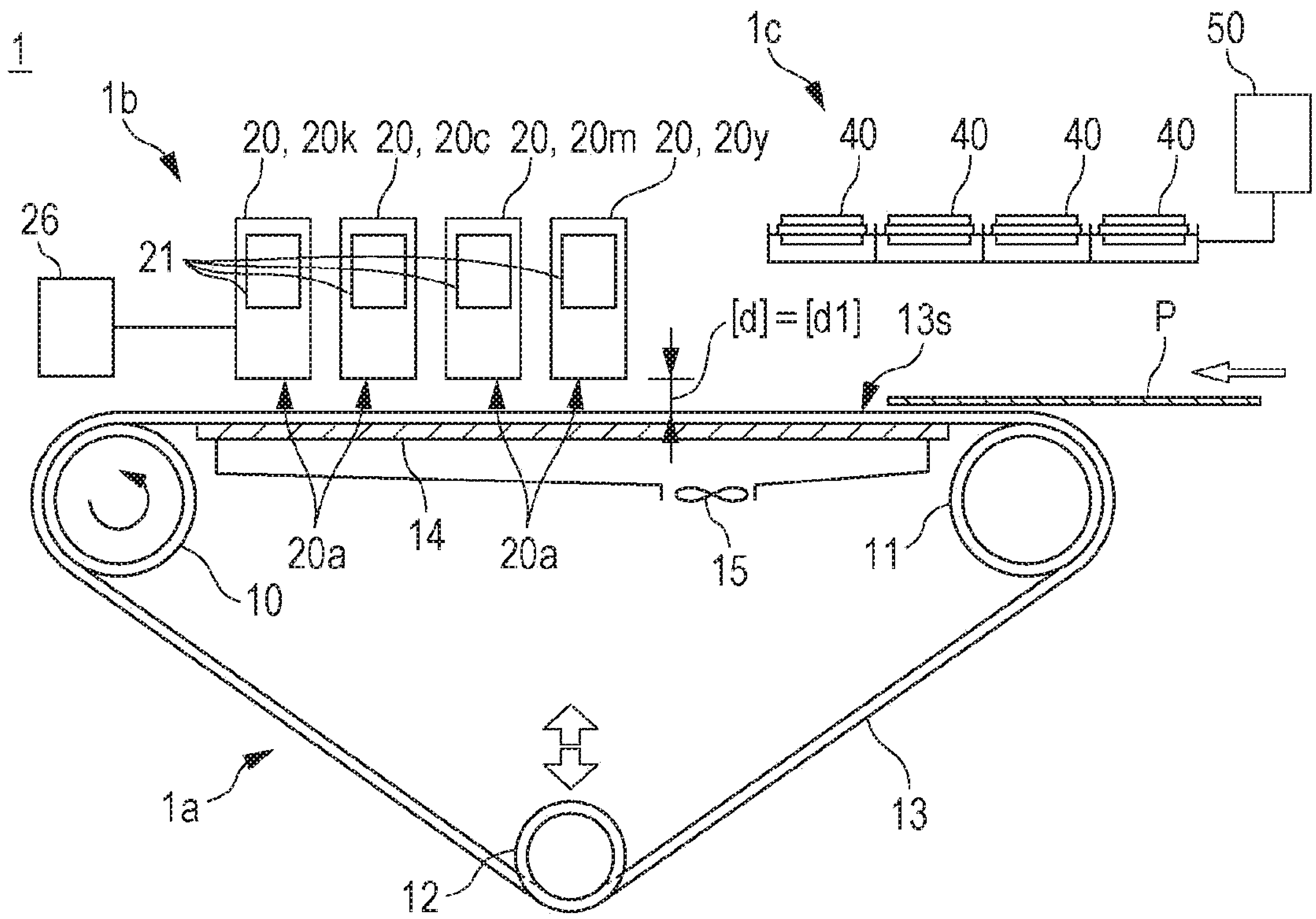

1
1b
1c
50
20, 20k
20, 20c
20, 20m
20, 20y
40
26
21
[d] = [d1]
13s
P
20a
14
20a
15
11
10
1a
13
12

FIG. 2

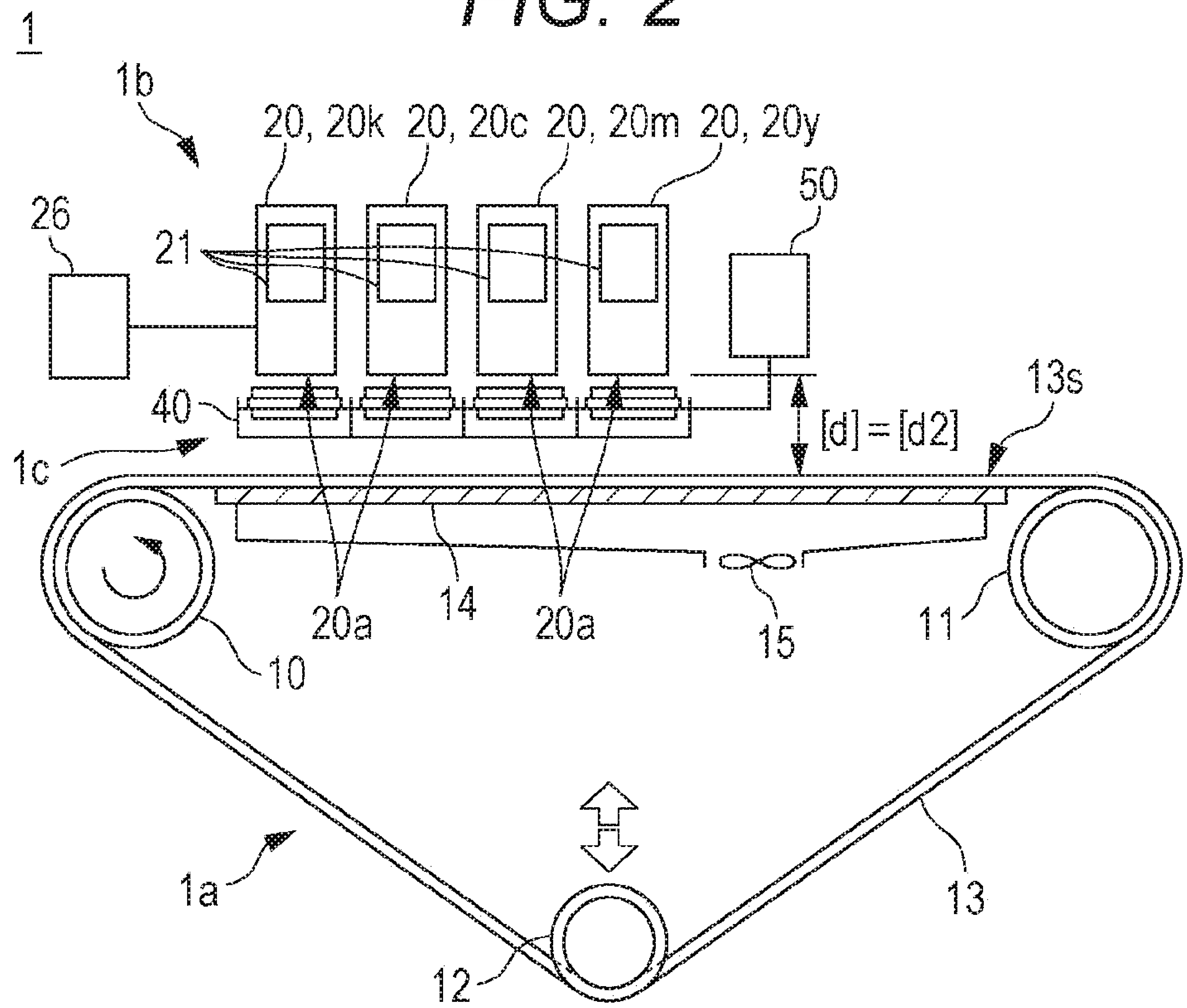

1
1b
20, 20k
20, 20c
20, 20m
20, 20y
50
26
21
40
[d] = [d2]
13s
1c
20a
14
20a
15
11
10
1a
13
12

FIG. 3

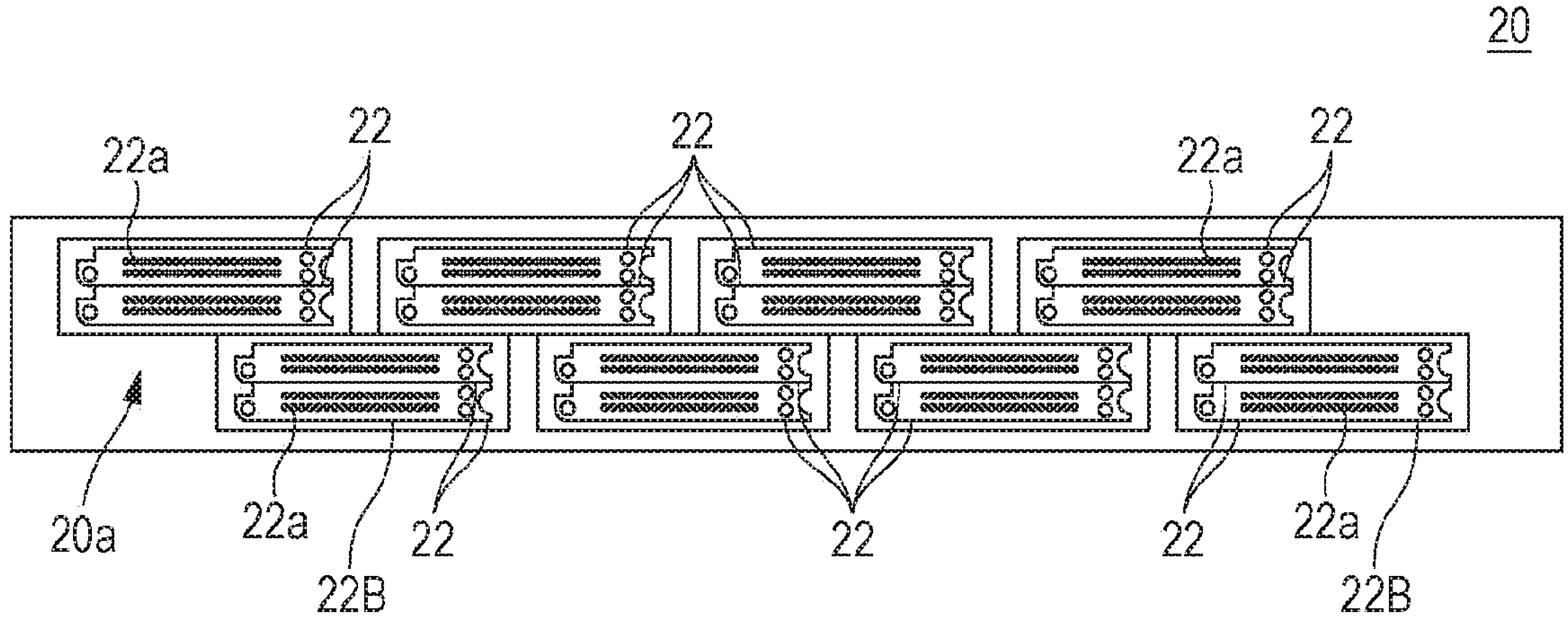

20
22a
22
22
22a
22
20a
22a
22B
22
22
22
22a
22B

FIG. 4

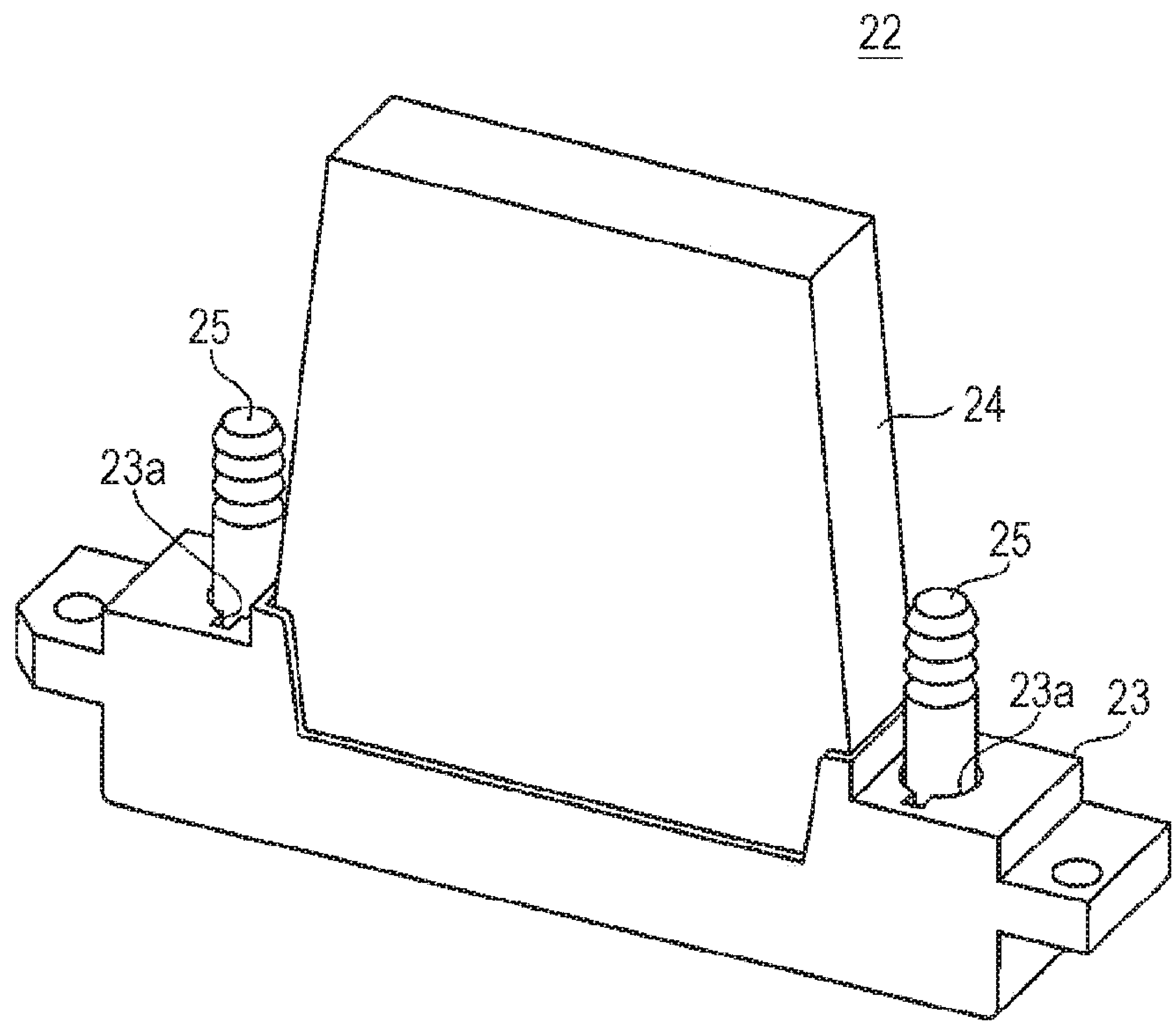
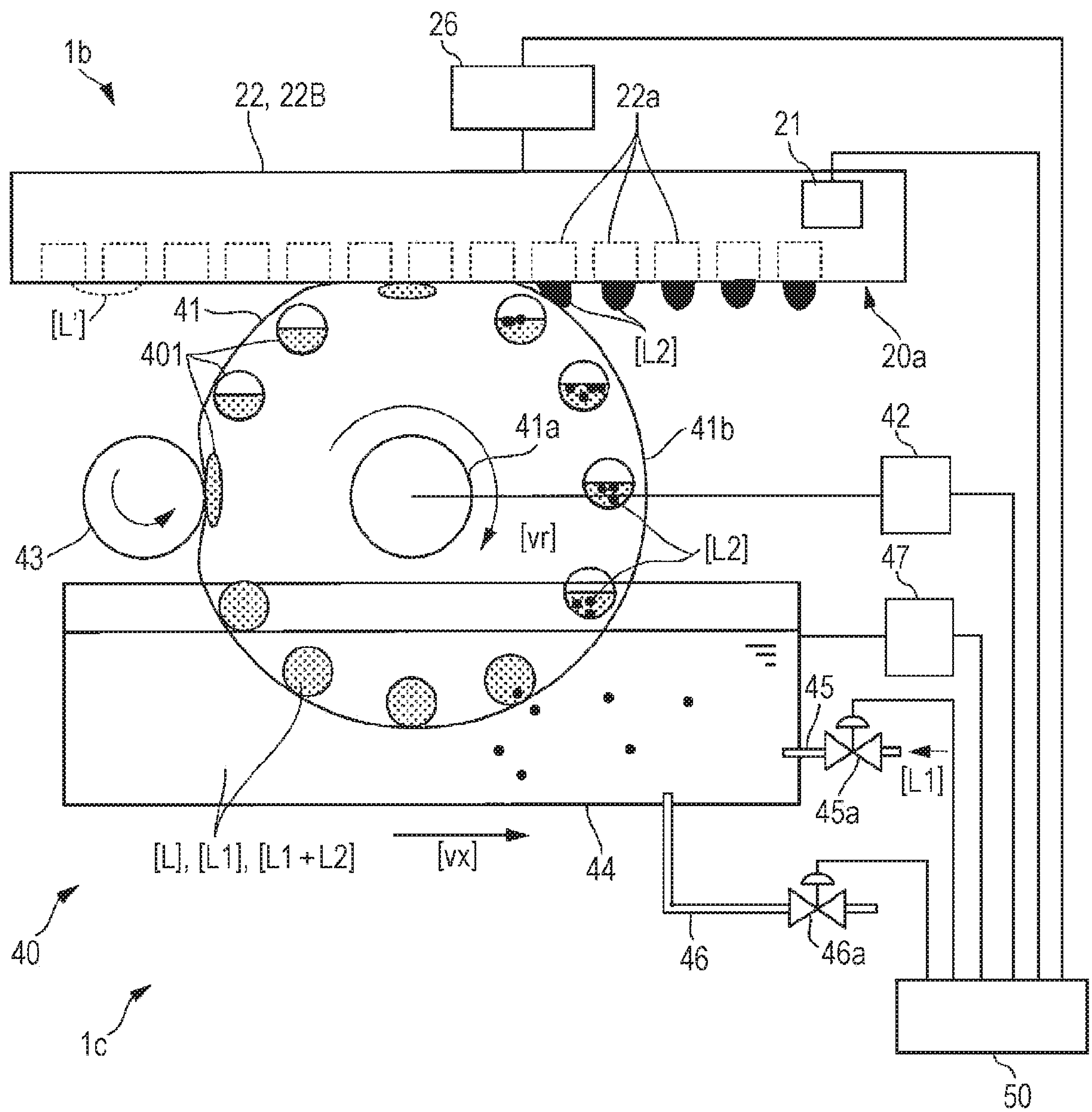

22
25
23a
24
25
23a
23

FIG. 5



1b
22, 22B
26
22a
21
[L']
41
401
[L2]
20a
41a
41b
42
43
[vr]
[L2]
47
45
45a
[L1]
[L], [L1], [L1+L2]
[vx]
44
40
46
46a
1c
50

FIG. 6

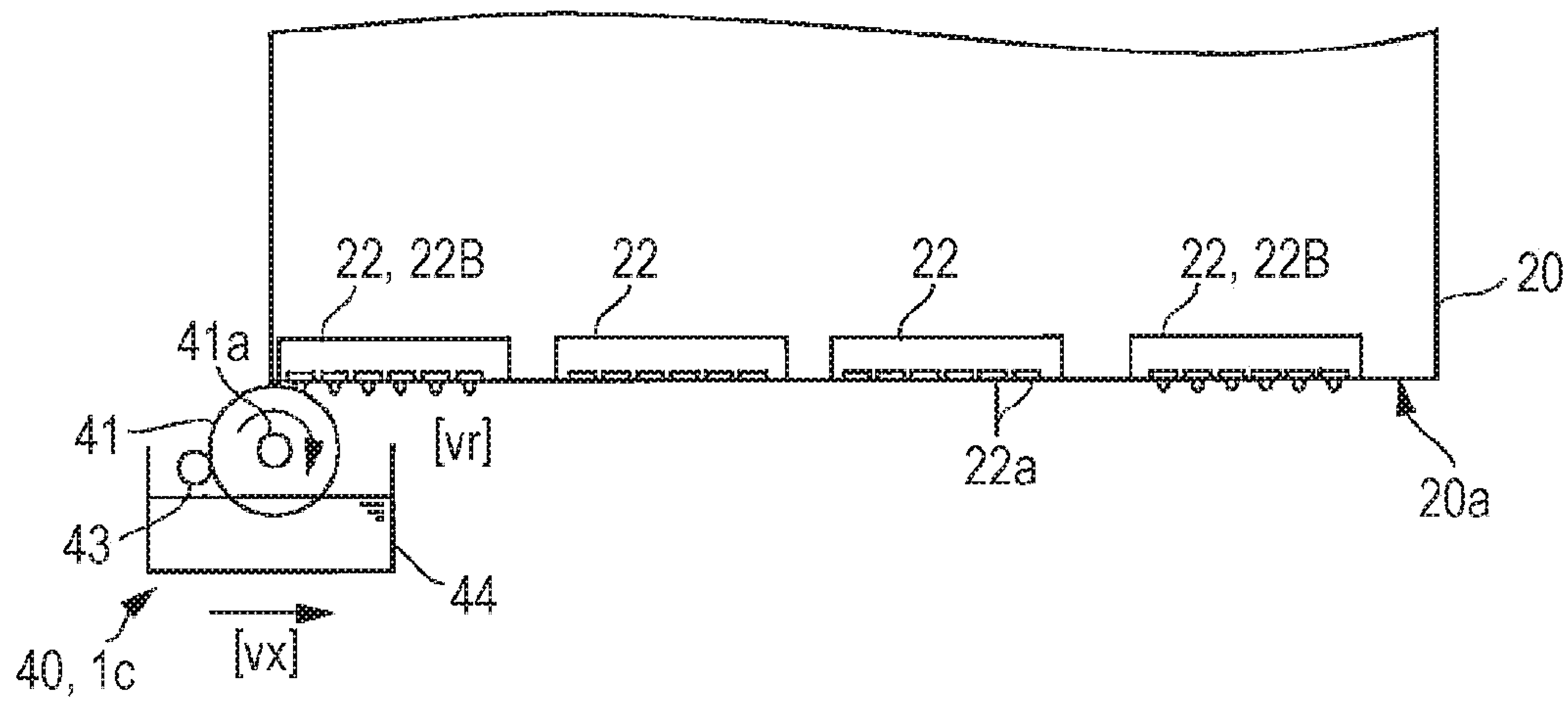


FIG. 7

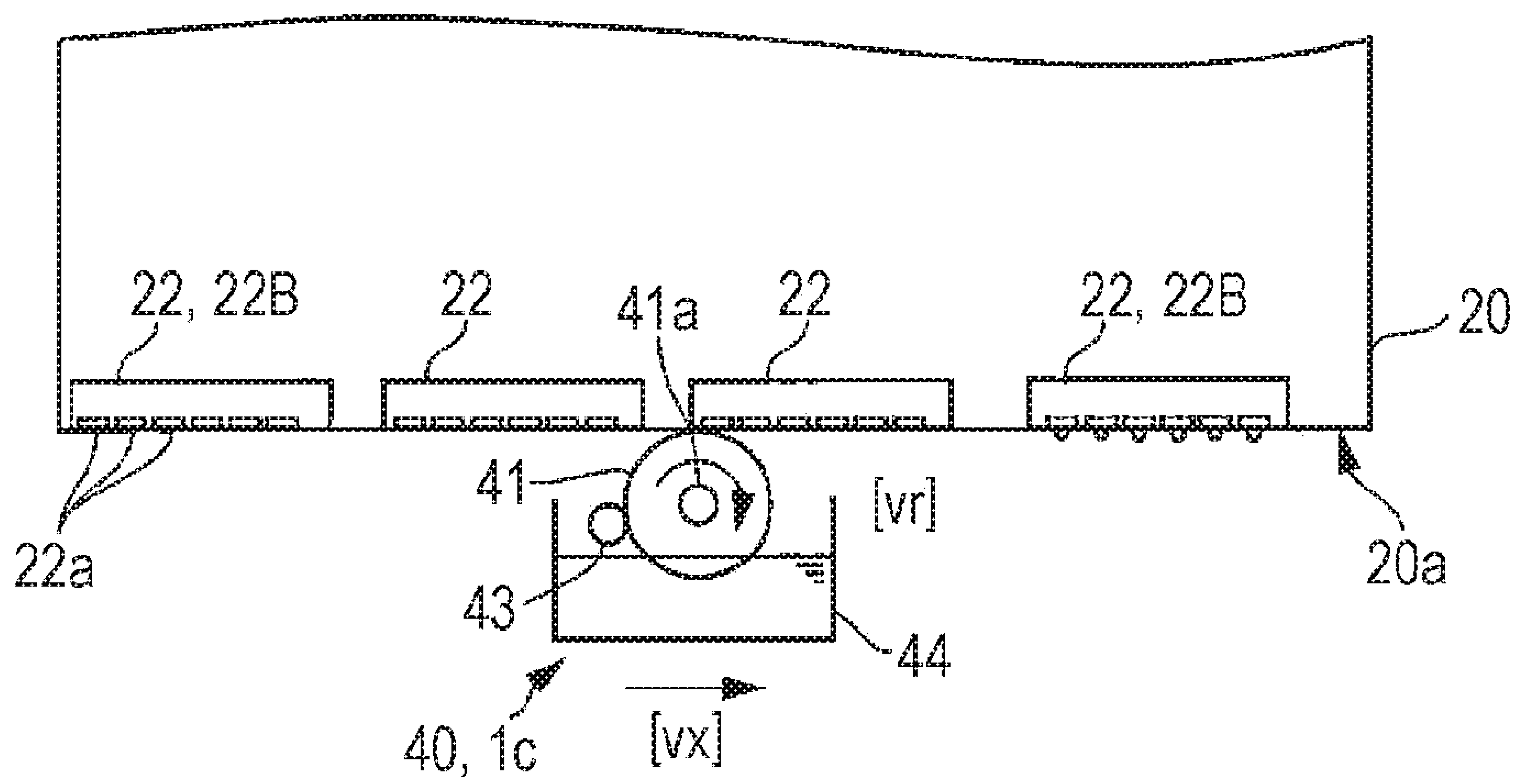


FIG. 8

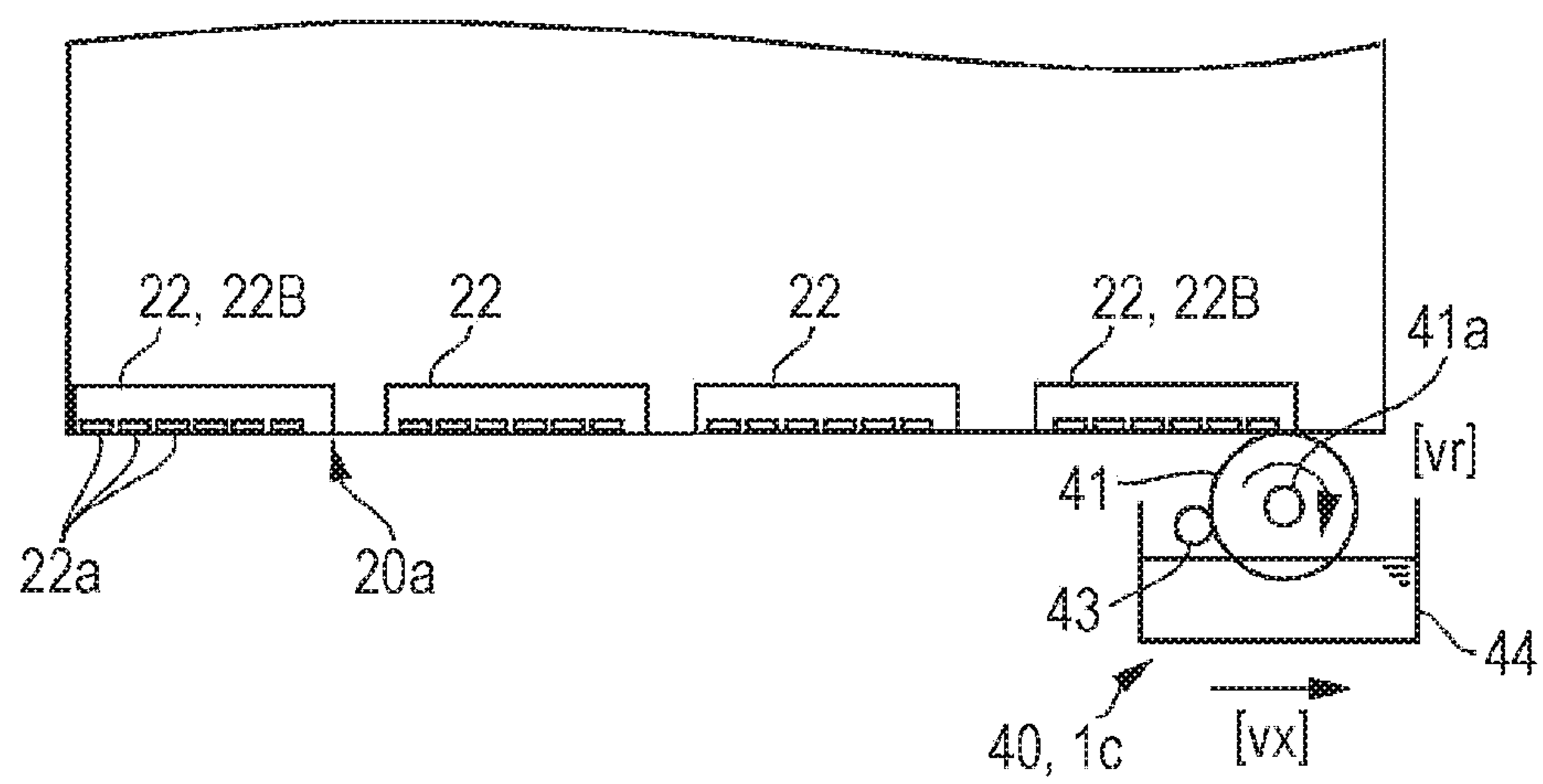


FIG. 9

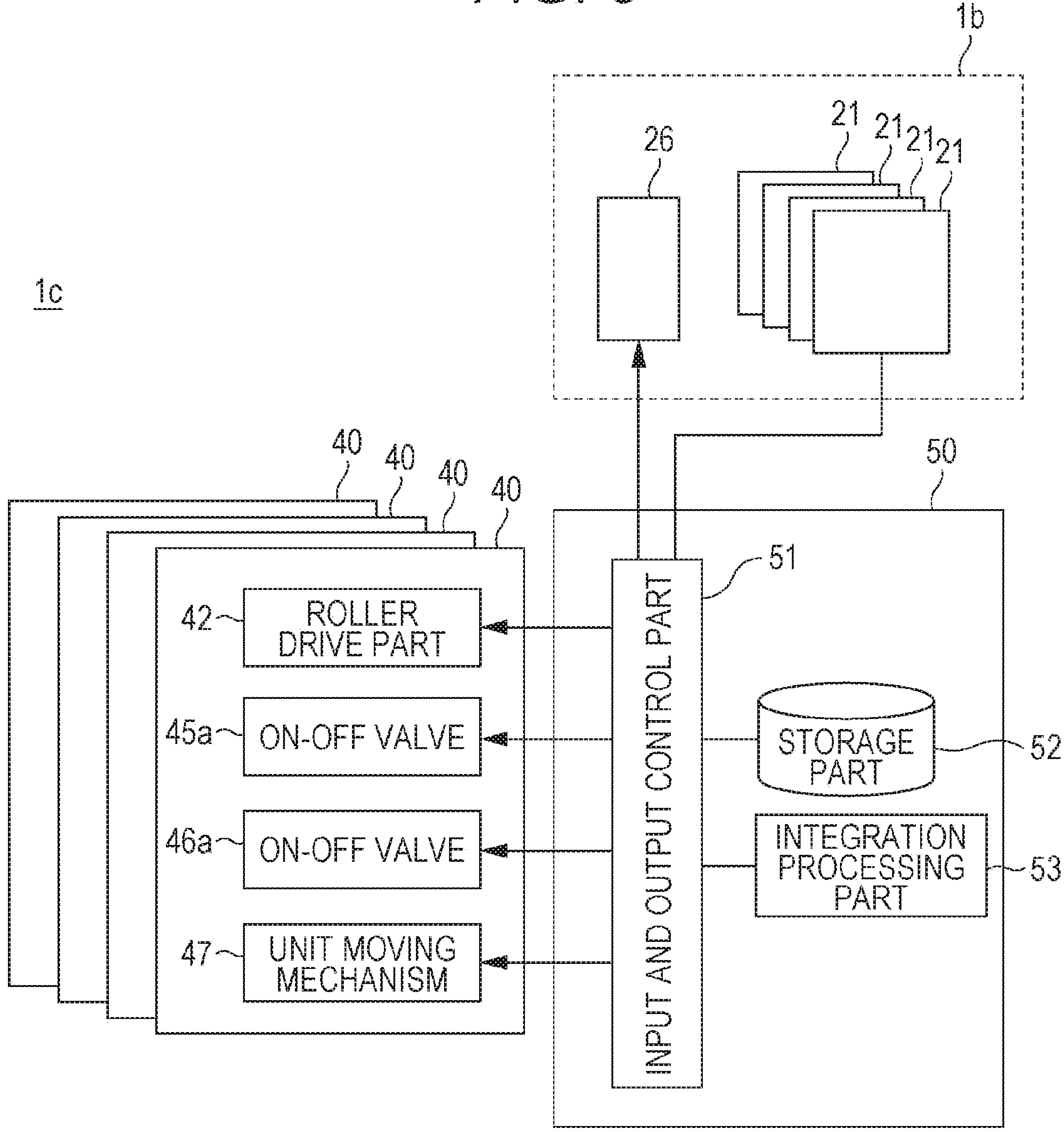

1b
26
21
21
21
21
1c
40
40
40
40
50
51
42
ROLLER DRIVE PART
45a
ON-OFF VALVE
46a
ON-OFF VALVE
47
UNIT MOVING MECHANISM
INPUT AND OUTPUT CONTROL PART
STORAGE PART
52
INTEGRATION PROCESSING PART
53

FIG. 10

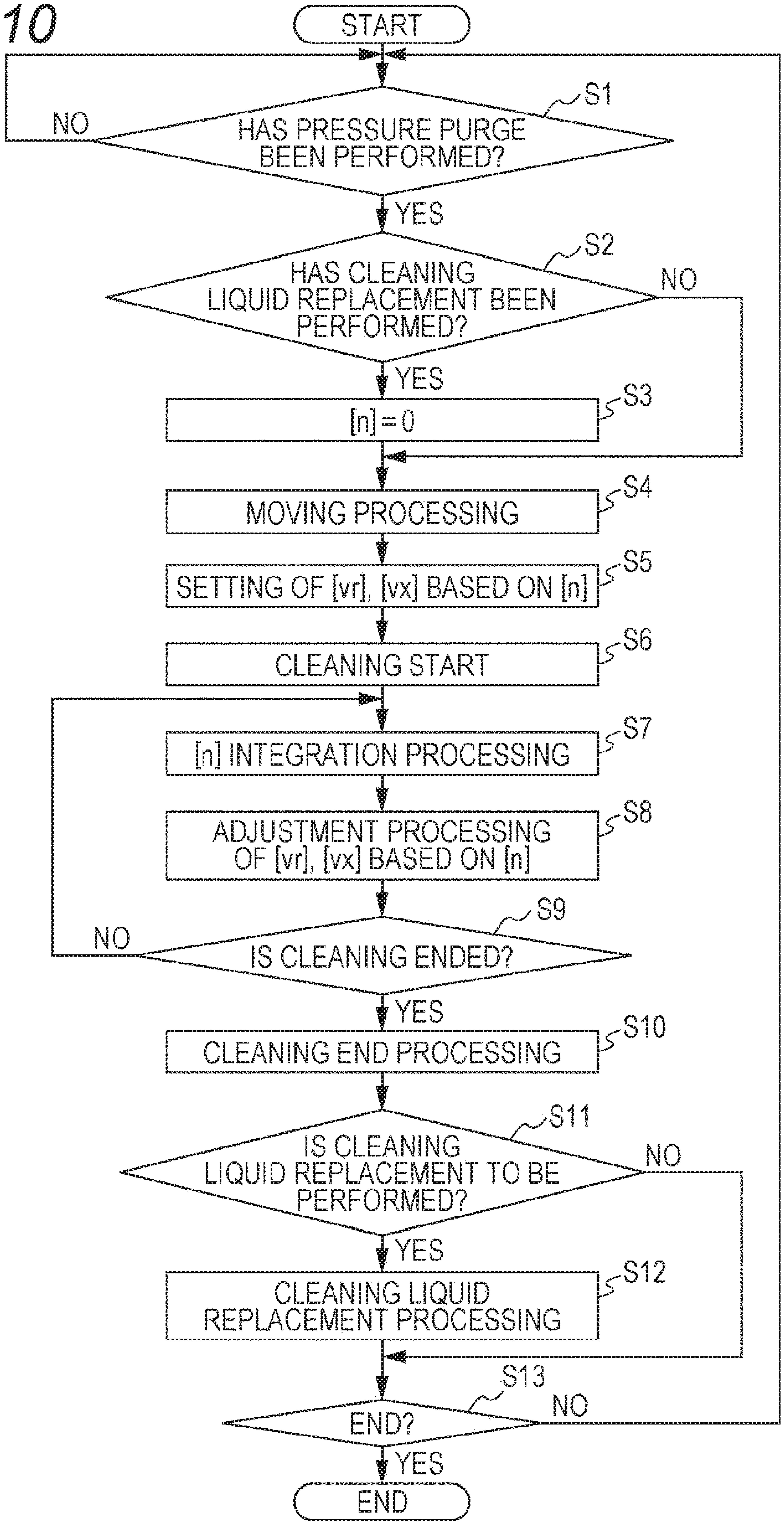

START
S1
HAS PRESSURE PURGE BEEN PERFORMED?
NO
YES
S2
HAS CLEANING LIQUID REPLACEMENT BEEN PERFORMED?
NO
YES
S3
[n] = 0
S4
MOVING PROCESSING
S5
SETTING OF [vr], [vx] BASED ON [n]
S6
CLEANING START
S7
[n] INTEGRATION PROCESSING
S8
ADJUSTMENT PROCESSING OF [vr], [vx] BASED ON [n]
S9
IS CLEANING ENDED?
NO
YES
S10
CLEANING END PROCESSING
S11
IS CLEANING LIQUID REPLACEMENT TO BE PERFORMED?
NO
YES
S12
CLEANING LIQUID REPLACEMENT PROCESSING
S13
END?
NO
YES
END

FIG. 11

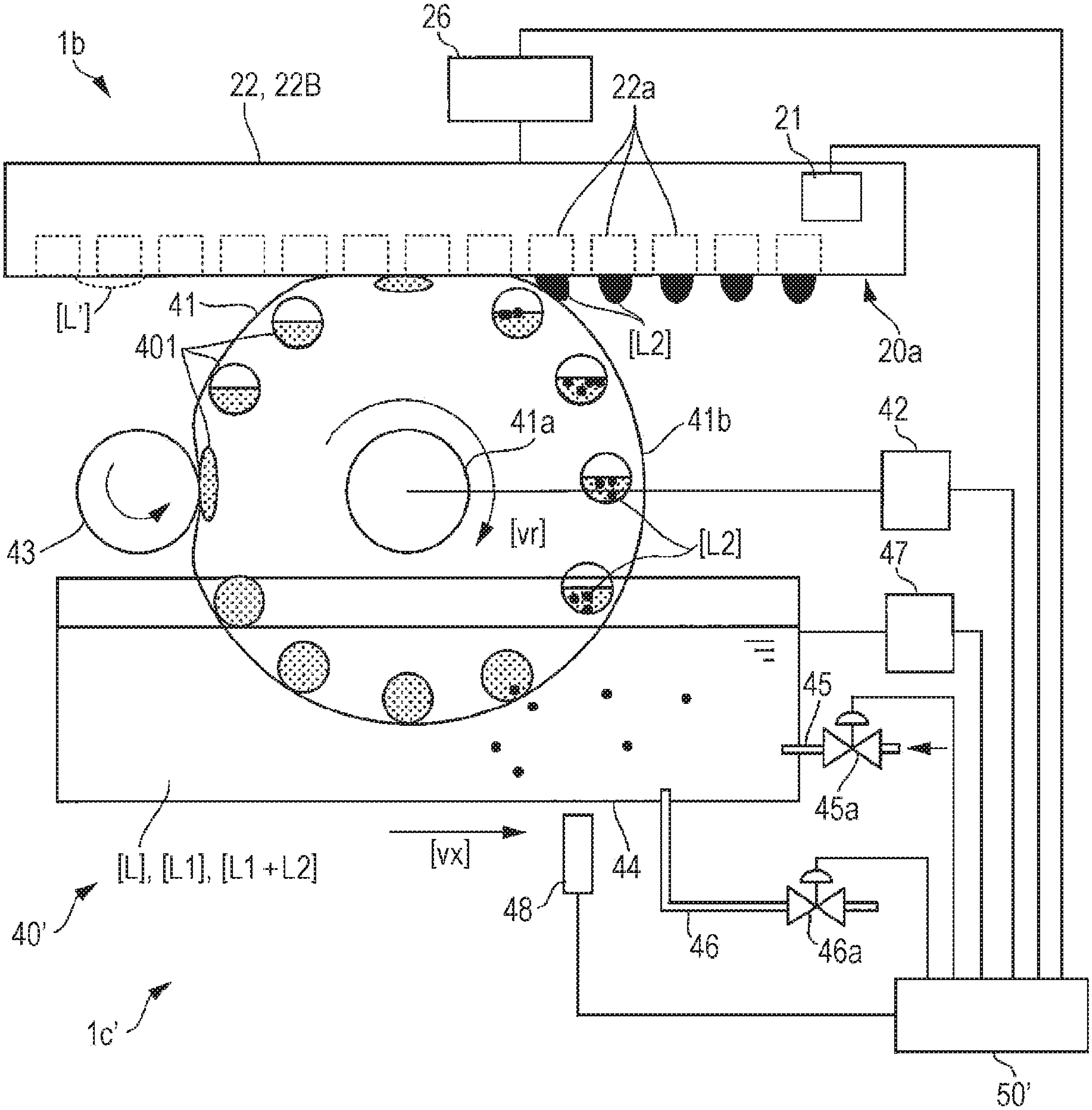

1b
26
22, 22B
22a
21
[L']
41
401
[L2]
20a
41a
41b
42
43
[vr]
[L2]
47
45
45a
[L], [L1], [L1+L2]
[vx]
48
44
46
46a
40'
1c'
50'

FIG. 12

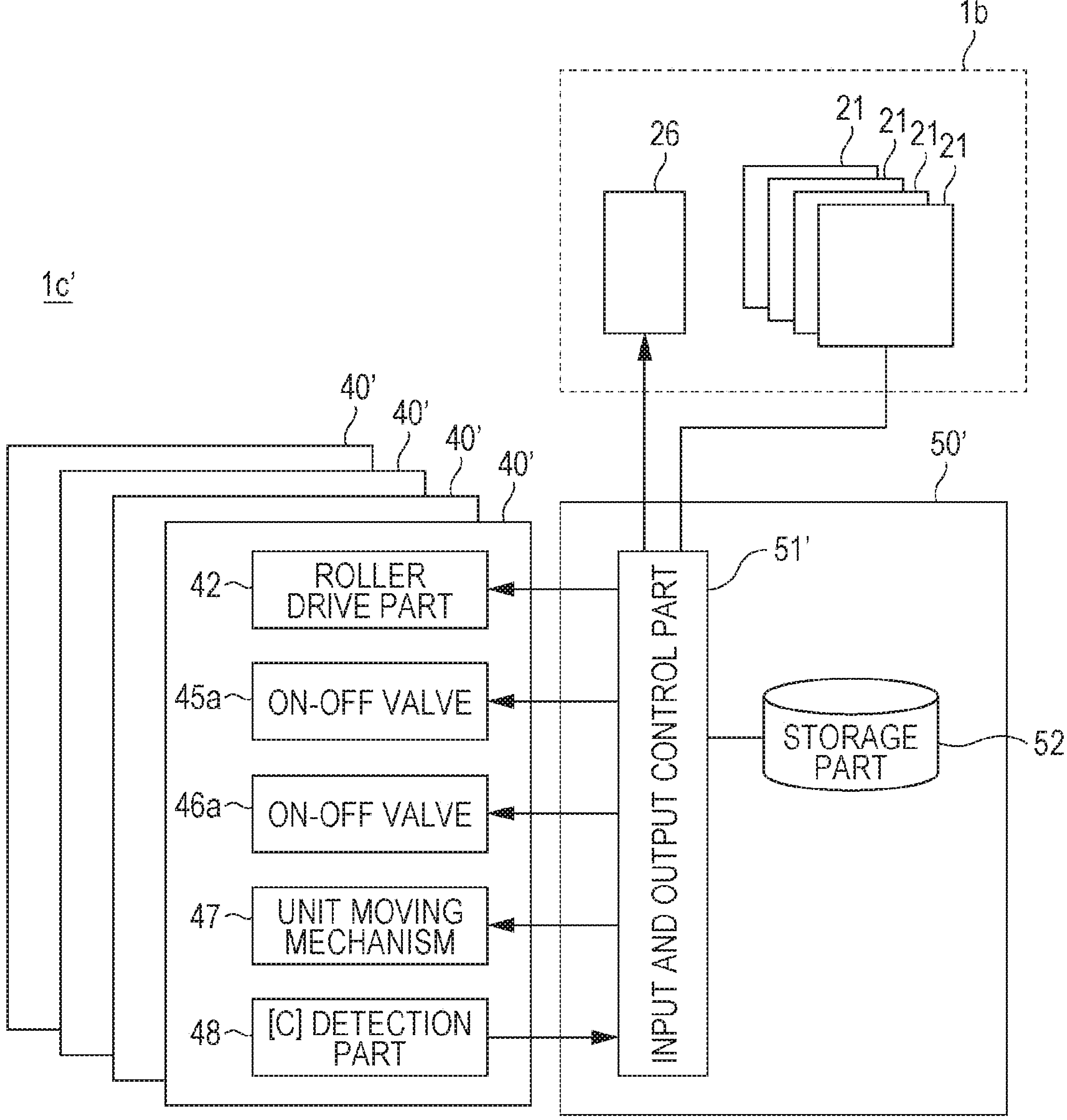

1b
26
21
21
21
21
1c'
40'
40'
40'
40'
50'
51'
42
ROLLER DRIVE PART
45a
ON-OFF VALVE
46a
ON-OFF VALVE
47
UNIT MOVING MECHANISM
48
[C] DETECTION PART
INPUT AND OUTPUT CONTROL PART
STORAGE PART
52

FIG. 13

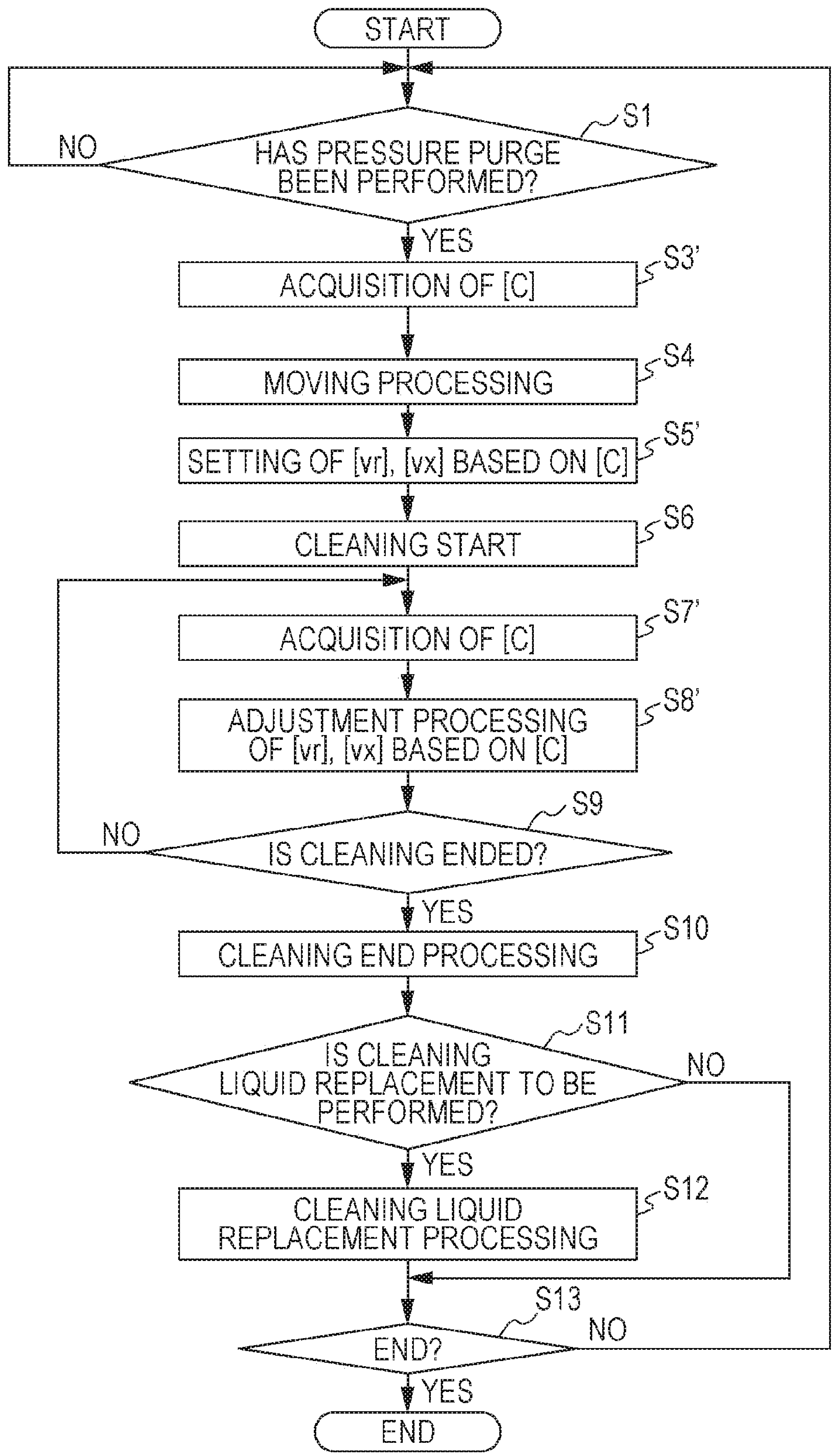

START
HAS PRESSURE PURGE BEEN PERFORMED?
S1
NO
YES
ACQUISITION OF [C]
S3'
MOVING PROCESSING
S4
SETTING OF [vr], [vx] BASED ON [C]
S5'
CLEANING START
S6
ACQUISITION OF [C]
S7'
ADJUSTMENT PROCESSING OF [vr], [vx] BASED ON [C]
S8'
IS CLEANING ENDED?
S9
NO
YES
CLEANING END PROCESSING
S10
IS CLEANING LIQUID REPLACEMENT TO BE PERFORMED?
S11
NO
YES
CLEANING LIQUID REPLACEMENT PROCESSING
S12
END?
S13
NO
YES
END

FIG. 14

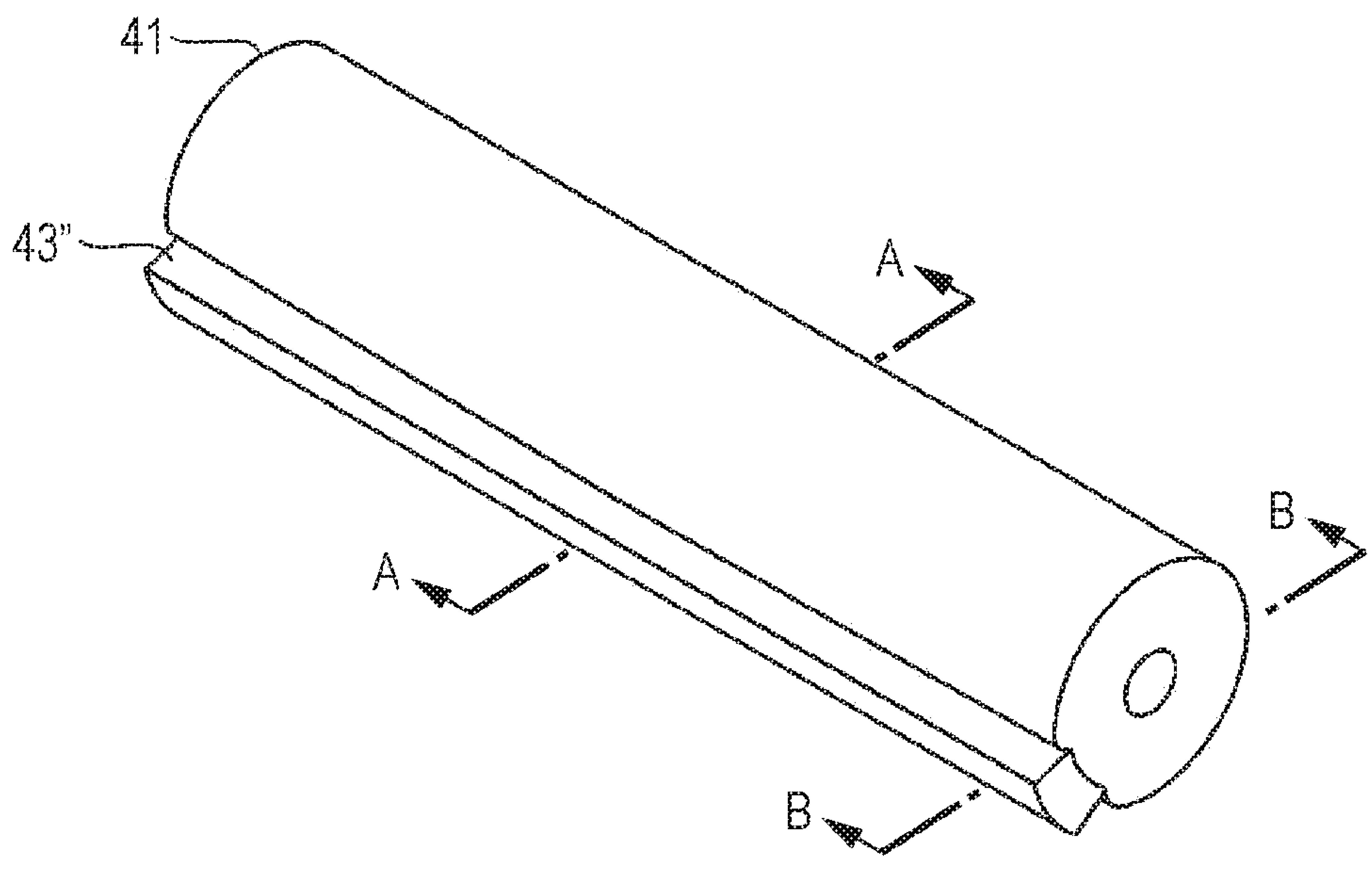


FIG. 15A

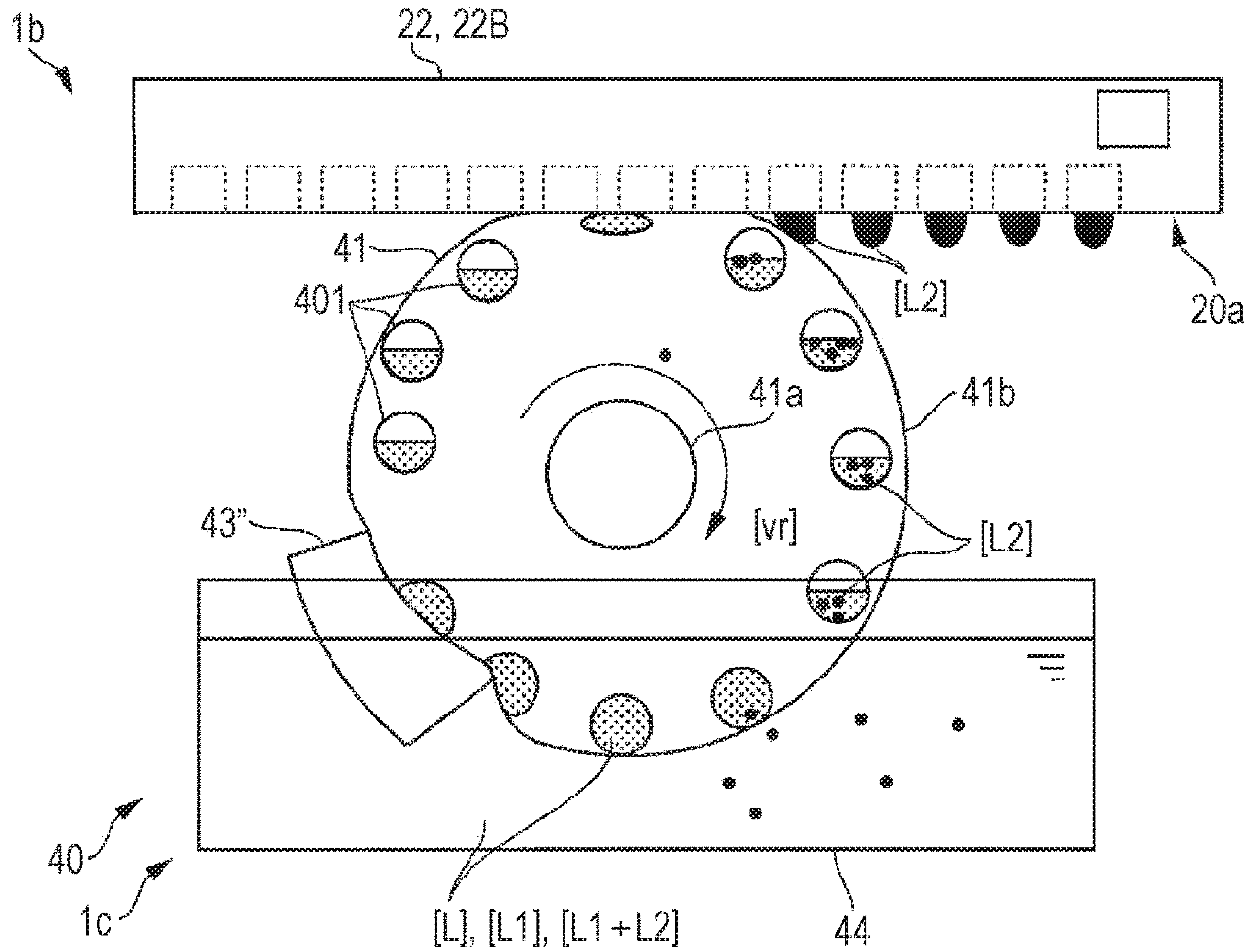
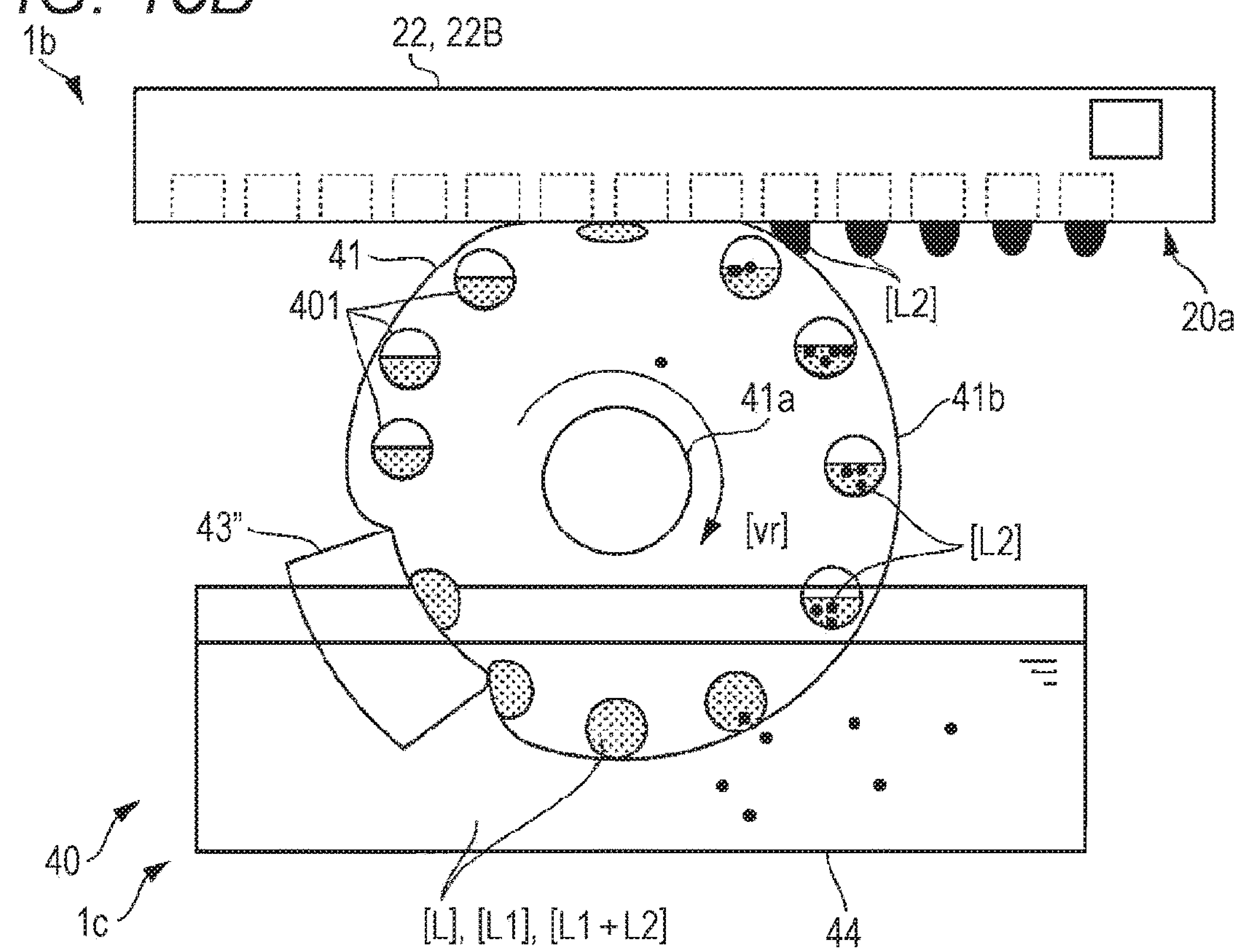


FIG. 15B



HEAD CLEANING DEVICE, IMAGE FORMING DEVICE, AND HEAD CLEANING METHOD OF IMAGE FORMING DEVICE

The entire disclosure of Japanese patent Application No. 2018-128075, filed on Jul. 5, 2018, is incorporated herein by reference in its entirety.

BACKGROUND

Technological Field

The present invention relates to a head cleaning device, an image forming device, and a head cleaning method of the image forming device.

Description of the Related Art

An inkjet type image forming device includes a head cleaning device for cleaning a nozzle surface on which a nozzle opening of an ink head is arranged. As the head cleaning device, there are devices provided with a conductive cleaning roller and devices provided with a porous cleaning roller for impregnating a cleaning liquid. These cleaning rollers rotate in a state in which the outer circumferential surface faces a nozzle surface, and move along the nozzle surface in a further rotated state, and have a configuration in which ink or bubble attached to the nozzle opening and the nozzle surface is moved to the outer circumferential surface side of the cleaning roller, and removed.

Among these, regarding the head cleaning device provided with a conductive cleaning roller (roller for cleaning), JP 2012-179811 A discloses that a clearance between each ink discharge head and a cleaning roller (or a cleaning belt) at the time of cleaning of each ink discharge head, and a relative speed of each ink discharge head and an outer circumferential surface of the cleaning roller (or a surface of the cleaning belt) can be adjusted according to the characteristics of an ink used for recording, that is, the surface tension, viscosity or the like of the ink, so that the cleaning efficiency of each ink discharge head can be further improved regardless of the characteristics of the ink used for recording.

On the other hand, a head cleaning device provided with a porous cleaning roller is used in a state in which a lower part of a cleaning roller is immersed in a cleaning liquid. In such a porous cleaning roller, the ink moved to the outer circumferential surface side of the cleaning roller is absorbed together with the cleaning liquid into a hole formed on the outer circumferential surface side of the cleaning roller. The ink absorbed in the hole of the cleaning roller is replaced with the cleaning liquid stored in a storage tank in the storage tank.

For this reason, in the head cleaning device provided with the porous cleaning roller, the density of the ink relative to the cleaning liquid in the storage tank gradually increases with the increase in the number of cleaning of the ink head so that the surface tension of the cleaning liquid changes. Therefore, as the number of cleaning of the ink head increases, the surface tension of the cleaning liquid supplied to the nozzle surface in the state of being impregnated in the cleaning roller changes. Such a change in the surface tension of the cleaning liquid affects the wiping performance of the nozzle surface by the surface of the cleaning roller, which causes the generation of the remaining ink and the cleaning liquid containing the ink on the nozzle surface.

SUMMARY

Therefore, the present invention has an object to provide a head cleaning device capable of stably maintaining wiping performance of a nozzle surface by a porous cleaning roller impregnating a cleaning liquid, an image forming device provided with the head cleaning device, and a head cleaning method of the image forming device.

To achieve the abovementioned object, according to an aspect of the present invention, a head cleaning device reflecting one aspect of the present invention comprises a porous cleaning roller that is arranged with a cylindrical axis kept horizontal, rotates around the axis while a cylindrical side circumferential surface is in pressure contact with a nozzle surface of an ink head to clean the nozzle surface; a storage tank that is provided to store a cleaning liquid and immerse a lower part of the cleaning roller in the cleaning liquid stored; a unit moving mechanism that moves a cleaning unit including the storage tank and the cleaning roller in a direction perpendicular to the axis of the cleaning roller; a hardware processor that controls a rotation speed [vr] of the cleaning roller and a moving speed [vx] of the storage tank and the cleaning unit; and a composition acquisition part that acquires a change in composition of the cleaning liquid in the storage tank due to mixing of ink supplied from the nozzle surface through the cleaning roller, wherein the hardware processor controls a speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx] based on a change in the composition of the cleaning liquid acquired by the composition acquisition part.

BRIEF DESCRIPTION OF THE DRAWINGS

The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinbelow and the appended drawings which are given by way of illustration only, and thus are not intended as a definition of the limits of the present invention:

FIG. **1** is a main part configuration diagram (part **1**) of an image forming device according to a first embodiment;

FIG. **2** is a main part configuration diagram (part **2**) of the image forming device according to the first embodiment;

FIG. **3** is a bottom view of a head unit provided in the image forming device according to the first embodiment;

FIG. **4** is a perspective view of an ink head according to the first embodiment;

FIG. **5** is a configuration diagram of a head cleaning device according to the first embodiment;

FIG. **6** is a diagram (part **1**) explaining cleaning of a nozzle surface by the head cleaning device according to the first embodiment;

FIG. **7** is a diagram (part **2**) explaining the cleaning of the nozzle surface by the head cleaning device according to the first embodiment;

FIG. **8** is a diagram (part **3**) explaining the cleaning of the nozzle surface by the head cleaning device according to the first embodiment;

FIG. **9** is a block diagram of the head cleaning device according to the first embodiment;

FIG. **10** is a flowchart showing the procedure of the cleaning of the nozzle surface by the head cleaning device according to the first embodiment;

FIG. **11** is a configuration diagram of a head cleaning device according to a second embodiment;

FIG. **12** is a block diagram of the head cleaning device according to the second embodiment;

FIG. **13** is a flowchart showing the procedure of the cleaning of the nozzle surface by the head cleaning device according to the second embodiment;

FIG. **14** is a main part perspective view explaining a modification of a head cleaning device according to an embodiment; and

FIGS. **15**A and **15**B are main part sectional views explaining the modification of the head cleaning device according to an embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

Formation of implementation of a head cleaning device to which the present invention is applied, an image forming device provided with the head cleaning device, and an ink head cleaning method in the image forming device will be described below.

First Embodiment

(Image Forming Device)

FIG. **1** is a main part configuration diagram (part **1**) of an image forming device **1** according to a first embodiment, and FIG. **2** is a main part configuration diagram (part **2**) of the image forming device **1** according to the first embodiment. These drawings are the side views of an image formation part in the image forming device **1** of an inkjet type. As shown in these drawings, the image forming device **1** of the inkjet type according to the first embodiment includes a belt conveyance device **1***a*, an ink supply device **1***b*, and a head cleaning device **1***c*. These are formed as follows.

<Belt Conveyance Device **1***a*>

The belt conveyance device **1***a* is for conveying a recording medium P in a predetermined direction. The belt conveyance device **1***a* includes a drive roller **10**, a driven roller **11**, a tension control roller **12**, and an endless belt **13** stretched around them, and makes the endless belt **13** circle around by the rotation of the drive roller **10**. The endless belt **13** has a plurality of through holes, and an outer circumferential surface portion between the drive roller **10** and the driven roller **11** is a mounting surface **13***s* of the recording medium P.

The belt conveyance device **1***a* further includes a support **14** that supports the endless belt **13** from an inner circumferential side, and a suction fan **15**. The support **14** is a plate-like member for supporting the endless belt **13** from the inner circumferential side between the drive roller **10** and the driven roller **11**, and has a plurality of through holes communicating with the through holes of the endless belt **13**. The suction fan **15** sucks the air on the mounting surface **13***s* side of the endless belt **13** through the through holes of the support **14** and the through holes of the endless belt **13**, and causes the recording medium P supplied on the mounting surface **13***s* to be adsorbed to the mounting surface **13***s*. As a result, the belt conveyance device **1***a* is formed to convey the recording medium P in a state of being adsorbed to the mounting surface **13***s* in the circling direction of the endless belt **13**.

<Ink Supply Device **1***b*>

The ink supply device **1***b* is for supplying ink to the recording medium P conveyed by the belt conveyance device **1***a*. The ink supply device **1***b* has a plurality of head units **20** for supplying ink of each color. Each head unit **20** is provided with an ink head control part **21** for controlling the supply of ink.

Each head unit **20** is arranged along the conveyance direction of the recording medium P by the belt conveyance device **1***a* in a state where a nozzle surface **20***a* described below faces the mounting surface **13***s* of the belt conveyance device **1***a*. As an example, FIGS. **1** and **2** show a configuration in which a yellow head unit **20***y*, a magenta head unit **20***m*, a cyan head unit **20***c*, and a black head unit **20***k* are arranged in order along a conveyance direction of the recording medium P. However, the arrangement order of the head units **20** is not limited to this order.

FIG. **3** is a bottom view of the head unit **20** provided in the image forming device according to the first embodiment, and is a view of one of the head units **20** shown in FIGS. **1** and **2** viewed from the nozzle surface **20***a* side directed to the belt conveyance device **1***a*. As shown in FIG. **3**, the head unit **20** has a plurality of ink heads **22** arrayed along the nozzle surface **20***a* directed to the belt conveyance device **1***a* side. In the illustrated example, a pair of ink heads **22** is used as one set, and a plurality of sets (here, eight sets) of ink heads **22** are arranged in two rows in a zigzag.

The nozzle surface **20***a* of each head unit **20** is a water repellent surface, and is arranged with a nozzle opening **22***a* that is one opening of the nozzle formed in the ink head **22**. The ink head **22** of each head unit **20** discharges ink from the nozzle openings **22***a* on the basis of an instruction from the ink head control part **21** (see FIGS. **1** and **2**).

Each ink head **22** performs pressure purge on the basis of an instruction from the ink head control part **21** (see FIGS. **1** and **2**). Here, the pressure purge is processing performed to prevent clogging of the ink at the nozzle that has not discharged ink for a predetermined period, and in which the ink in the nozzle is forcibly pushed out by blowing air into the nozzle. Such pressure purge is selectively performed for each ink head **22**.

FIG. **4** is a perspective view of the ink head **22** according to the first embodiment. As shown in this drawing, each ink head **22** accommodates the main part of the ink head **22** inside an exterior material formed of a cover member **23** and a housing **24** fitted with the cover member **23**.

Among these, the cover member **23** accommodates a head chip in which a plurality of nozzles for discharging ink is formed, and holds the nozzle opening **22***a* (see FIG. **3**) at the tip of the nozzle in a state of being exposed to the outside. The cover member **23** accommodates a manifold for storing ink in a state of being communicated with each nozzle formed in the head chip. The cover member **23** as described above is provided with a takeout hole **23***a* through which a connector **25** for supplying ink into the manifold projects. The housing **24** accommodates a flexible printed board on which the ink head control part **21** (see FIGS. **1** and **2**) for controlling the discharge of ink from the nozzle opening **22***a* (see FIG. **3**) is formed.

Referring back to FIGS. **1** and **2**, the ink supply device **1***b* as described above includes a height adjustment mechanism **26** for adjusting the height position of each head unit **20**. As a result, the height position of the belt conveyance device **1***a* relative to the mounting surface **13***s* can be adjusted freely, and the interval [d] between the nozzle surface **20***a* of each head unit **20** and the mounting surface **13***s* of the endless belt **13** can be freely changed. Here, the interval [d]=[d**1**] shown in FIG. **1** is an interval at the time of image formation, and is an interval [d**1**] when an image is formed on the recording medium P by the ink supply from the ink supply device **1***b*. On the other hand, the interval [d]=[d**2**] shown in FIG. **2** is an interval at the time of head cleaning, and is an interval [d2] when the nozzle surface **20***a* of each head unit **20** is cleaned. The interval [d2] is such a size that the cleaning unit **40** of the head cleaning device **1***c* described below is arranged at the interval [d2].

<Head Cleaning Device **1***c*>

The head cleaning device **1***c* is for cleaning the nozzle surface **20***a* of each head unit **20**. The head cleaning device **1***c* has a plurality of cleaning units **40** corresponding to each head unit **20** and a cleaning control part **50**. These are formed as follows.

—Cleaning Unit **40**—

Each cleaning unit **40** is located at a sheltered position away from each head unit **20** at the time of image formation shown in FIG. **1**. On the other hand, at the time of head cleaning shown in FIG. **2**, each cleaning unit **40** is located between the nozzle surface **20***a* of each head unit **20** and the mounting surface **13***s* of the endless belt **13**.

FIG. **5** is a configuration diagram of the head cleaning device **1***c* according to the first embodiment, and is a view representatively showing one of the cleaning units **40** shown in FIGS. **1** and **2**. FIG. **5** shows the state of the cleaning unit **40** at the time of head cleaning (see FIG. **2**) when the ink supply device **1***b* performs the pressure purge, together with the ink head **22**B subjected to the pressure purge.

As shown in this drawing, each cleaning unit **40** provided in the head cleaning device **1***c* includes a cleaning roller **41**, a roller drive part **42**, a throttle member **43**, a storage tank **44**, a supply pipe **45**, a drain pipe **46**, and a unit moving mechanism **47**. These members are formed as follows.

[Cleaning Roller **41**]

The cleaning roller **41** has a cylindrical wiping member **41***b* coaxially mounted on a roller shaft **41***a*. The roller shaft **41***a* is rotatably supported by a support means (not shown). The roller shaft **41***a* as described above is preferably made of a material that is high in rigidity and difficult to rust, and is made of, for example, stainless steel. On the other hand, the wiping member **41***b* is made of a porous material having elasticity, and is used by impregnating a porous hole portion **401** with the cleaning liquid [L]. The cleaning liquid [L] to be impregnated into the hole portion **401** of the cleaning roller **41** is a liquid stored in the storage tank **44** described below. It is preferable that the wiping member **41***b* as described above be formed to be attachable to and removable from the roller shaft **41***a* in order to facilitate replacement when the wiping member **41***b* is exhausted.

The cleaning roller **41** forms a nip portion in which the side circumferential surface formed by the wiping member **41***b* is brought into pressure contact with the nozzle surface **20***a* of the ink supply device **1***b* during head cleaning, and is positioned and arranged in the vertical direction such that the nip amount of the nip portion is within a range of appropriate values. The cleaning roller **41** is arranged in a state in which the lower part is immersed in the cleaning liquid [L] stored in the storage tank **44** described below at the time of head cleaning. In this state, when the cleaning roller **41** rotates, the wiping member **41***b* impregnated with the cleaning liquid [L] in the storage tank **44** slides against the nozzle surface **20***a* of the ink supply device **1***b*, and wipes off the ink [L2] of the nozzle surface **20***a* and the nozzle opening **22***a* located on the nozzle surface **20***a*. The ink [L2] of each nozzle opening **22***a* is the ink [L2] forcibly discharged from the nozzle opening **22***a* by the pressure purge.

Here, the coefficient of thermal expansion of the wiping member **41***b* in the state impregnated with the cleaning liquid [L] is set so as to be ±0.5 mm or less centering on the nip amount at room temperature (25° C.). As a result, it is possible to perform preferable cleaning regardless of the environmental temperature. Specifically, the nip amount is preferably in the range of 0.85 to 1.85 mm (1.35±0.5 mm).

It is preferable that the expansion of the outer diameter of the wiping member **41***b* due to the impregnation of the cleaning liquid [L] at 25° C. be 0.5 mm or less, since the wiping member **41***b* can perform preferable cleaning regardless of the impregnation rate of the cleaning liquid [L]. As a result, regardless of the impregnation rate of the cleaning liquid [L] in the wiping member **41***b*, the outer diameter of the wiping member **41***b* can be within the range of the nip amount (1.35±0.5 mm), and preferable cleaning can be performed.

It is preferable that an average porosity be 70% or more and an average pore diameter measured by a porosimeter be 700 μm or less, since the wiping member **41***b* can perform preferable cleaning Here, the average porosity can be determined by determining the sample volume (true volume) from the gas law of the pressure change boiler by one of gas replacement methods, and using the ratio between the sample volume and the apparent volume of this sample. The average pore diameter can also be determined by adopting an average value of several (five to ten pieces, different depending on the sample) in descending order of the pores confirmed in the electron micrograph of the sample, the average value measured with a measure printed on the electron micrograph.

The wiping member **41***b* having the above-described characteristics is made of, for example, a porous material having open cells made of a plastic polymer or the like. Particularly, as the material of the wiping member **41***b* which satisfies the above conditions, in particular, polyurethane is preferable. Specifically, for example, when Lubilar L31 (trade name, Toyo Polymer Co., Ltd.) is used as the material, particularly preferable cleaning effect can be obtained. Since the said material can be processed and preserved in a dry state, it is suitable as the wiping member **41***b* also at the point that it is easy to be stored and handled.

The outer diameter of the wiping member **41***b* can be appropriately selected in accordance with the size of the head unit **20**, but it is preferable to set the outer diameter to 20 to 50 mm in order to perform preferable cleaning. This is because, if the outer diameter of the wiping member **41***b* is set to 20 mm or more, after the wiping member **41***b* is pressed with the throttle member **43** described later, it becomes easy to secure time for the wiping member **41***b* to be restored before wiping the nozzle surface **20***a*, while, if the outer diameter of the wiping member **41***b* is 50 mm or less, manufacture is facilitated.

[Roller Drive Part **42**]

The roller drive part **42** is a part that rotates the cleaning roller **41** described above, and includes, for example, a motor. The roller drive part **42** rotates the cleaning roller **41** at a rotation speed [vr] instructed by the cleaning control part **50** described below.

[Throttle Member **43**]

The throttle member **43** is provided in a state of being in pressure contact with the side circumferential surface of the cleaning roller **41** constituted by the wiping member **41***b*, and controls the amount of the cleaning liquid [L] impregnated in the wiping member **41***b*. The throttle member **43** as described above is made of a material harder than the wiping member **41***b*, such as hard rubber or stainless steel, and for example, is a roller shape having the length with which the throttle member **43** can press the side circumferential surface of the cleaning roller **41** in the entire width direction of the cleaning roller **41**. The roller-shaped throttle member **43** is rotatably supported by a support member (not shown), and rotates following the rotation of the cleaning roller **41**, and the pressing force on the cleaning roller **41** can be adjusted.

The throttle member **43** as described above is located downstream of the liquid surface of the cleaning liquid [L] in the storage tank **44** in the rotation direction of the cleaning roller **41**, and upstream of the nip portion between the cleaning roller **41** and the nozzle surface **20***a* of the head unit **20**. As a result, after the wiping member **41***b* of the cleaning roller **41** impregnates the cleaning liquid [L], the throttle member **43** is formed to press the wiping member **41***b* in the radial direction before wiping the nozzle surface **20***a* of the head unit **20**, and adjust the amount of impregnation of the cleaning liquid [L] in the wiping member **41***b* to an appropriate amount.

The amount of biting of the throttle member **43** into the wiping member **41***b* is preferably 0.5 mm or more and 60% or less of the thickness of the wiping member **41***b*, and is particularly preferably adjusted within a range of 0.5 mm or more and 50% or less of the thickness of the wiping member **41***b* in view of optimizing the throttling amount of the cleaning liquid [L]. As described above, since the cleaning liquid [L] impregnated in the wiping member **41***b* can be adjusted to an appropriate amount by the throttle member **43**, the dispersion of the impregnation ratio of the cleaning liquid in the wiping member **41***b* is suppressed, and the dispersion of the expansion of the outer diameter due to the impregnation of the cleaning liquid can also be suppressed.

Although the example using the roller-shaped throttle member **43** is described above as a method of adjusting the amount of impregnation of the cleaning liquid [L] in the wiping member **41***b*, it can be changed as appropriate as long as it is a method capable of adjusting the amount of impregnation, and, for example, a spatula-shaped throttle plate may be used as the throttle member **43**.

By appropriately selecting the material, porosity, pore diameter, and the like of the wiping member **41***b*, and by appropriately setting the rotation speed [vr] of the cleaning roller **41**, even in the absence of the throttle member **43**, the amount of impregnation of the cleaning liquid [L] in the wiping member **41***b* can be made appropriate, and in this case, the throttle member **43** can be omitted.

[Storage Tank **44**]

The storage tank **44** is for storing the cleaning liquid [L] and impregnating the wiping member **41***b* of the cleaning roller **41** with the cleaning liquid [L] by immersing the lower part of the cleaning roller **41** in the stored cleaning liquid [L]. The storage tank **44** as described above may be, for example, a single tank type or a two tank type.

The cleaning liquid [L] stored in the storage tank **44** is a cleaning liquid [L**1**] in the initial state supplied from the supply pipe **45** described below, or the cleaning liquid [L**1**] in the initial state mixed with ink [L**2**] supplied from the hole portion **401** of the cleaning roller **41**. As the cleaning liquid [L**1**] in the initial state supplied from the supply pipe **45**, for example, pure water or the like is used. A surfactant or the like may be appropriately added to the cleaning liquid [L**1**] in the initial state in order to enhance the detergency, and the liquid is preferably a liquid that does not occur aggregation even when mixed with the ink [L**2**], and does not significantly change the characteristics such as viscosity and surface tension of the ink [L**2**]. Specifically, an ink liquid from which a dye or a pigment is removed is suitable. It is preferable to put a preservative or the like in view of long-term storage of the cleaning liquid [L]. It is preferable to add an antifoaming agent since bubbles are less likely to be generated in the cleaning liquid [L] at the time of cleaning.

[Supply Pipe **45**]

The supply pipe **45** is a pipe for supplying the cleaning liquid [L**1**] to the storage tank **44**. The supply pipe **45** is provided with an on-off valve **45***a*, and can freely supply the cleaning liquid [L**1**] from the cleaning liquid storage part (not shown) into the storage tank **44** via the supply pipe **45** by driving of the on-off valve **45***a*. The on-off valve **45***a* as described above is a motor-operated valve that can freely open and close the supply pipe **45** according to an instruction from the cleaning control part **50** described below, and is, for example, a solenoid valve or a motor-operated valve.

[Drain Pipe **46**]

The drain pipe **46** is a pipe for discharging the cleaning liquid [L] from the storage tank **44**. The drain pipe **46** is provided with an on-off valve **46***a*, and can freely discharge the cleaning liquid [L] from the inside of the storage tank **44** to the waste liquid storage part (not shown) via the drain pipe **46** by driving of the on-off valve **46***a*. The on-off valve **46***a* as described above is a motor-operated valve that can freely open and close the drain pipe **46** according to an instruction from the cleaning control part **50** described below, and is, for example, a solenoid valve or a motor-operated valve.

[Unit Moving Mechanism **47**]

The unit moving mechanism **47** is a mechanism for moving each cleaning unit **40**. At the time of image formation (see FIG. **1**), the unit moving mechanism **47** retracts the cleaning unit **40** to a retraction place apart from each head unit **20**. On the other hand, at the time of head cleaning (see FIG. **2**), each cleaning unit **40** is located between the nozzle surface **20***a* of each head unit **20** and the mounting surface **13***s* of the endless belt **13** in a predetermined state of each cleaning unit **40**. In this case, as described above, the unit moving mechanism **47** adjusts the height of each cleaning unit **40** such that the side circumferential surface formed by the wiping member **41***b* of the cleaning roller **41** is brought into pressure contact with the nozzle surface **20***a* of each head unit **20** by a predetermined nip amount.

Here, FIGS. **6** to **8** show (part **1**) to (part **3**) explaining the cleaning of the nozzle surface **20***a* by the head cleaning device **1***c* according to the first embodiment. These drawings correspond to a view of the pair of head unit **20** and the cleaning unit **40** at the time of head cleaning as viewed from the axial direction of the cleaning roller **41**.

As shown in these drawings, the unit moving mechanism **47** moves the cleaning roller **41** relative to the nozzle surface **20***a* of each head unit **20** at a predetermined moving speed [vx] at the time of head cleaning.

Here, the cleaning roller **41** is arranged in a state where the roller shaft **41***a* is directed perpendicularly to the extending direction of the nozzle surface **20***a*. The unit moving mechanism **47** moves the cleaning roller **41** arranged in this manner in one of the directions perpendicular to the roller shaft **41***a* of the cleaning roller **41** and parallel to the nozzle surface **20***a*. It is preferable that the moving direction of the cleaning roller **41** be the same as the rotation direction of the cleaning roller **41** in the nip portion between the nozzle surface **20***a* and the cleaning roller **41**.

The unit moving mechanism **47** moves the throttle member **43** and the storage tank **44** together with the cleaning roller **41** at the moving speed [vx] while maintaining the positional relationship with the cleaning roller **41**. It is assumed that the movement of each cleaning unit **40** by the unit moving mechanism **47** at the time of the head cleaning is individually implemented for each cleaning unit **40**.

—Cleaning Control Part **50**—

FIG. **9** is a block diagram of the head cleaning device **1***c* according to the first embodiment and is a view mainly explaining the configuration of the cleaning control part **50**. The cleaning control part **50** controls the operation of each part of the cleaning unit **40**, and is formed by a computer such as a microcomputer. The computer includes a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM).

The cleaning control part **50** as described above includes an input and output control part **51**, a storage part **52**, and an integration processing part **53**. Each of these parts has a function to be described next, and the CPU in the cleaning control part **50** reads out and executes a program stored in the ROM to realize each function. Hereinafter, the details of each part constituting the cleaning control part **50** will be described on the basis of FIG. **9** and FIG. **5** described above.

[Input and Output Control Part **51**]

The input and output control part **51** is connected to the roller drive part **42**, the on-off valves **45***a*, **46***a*, and the unit moving mechanism **47** of each cleaning unit **40**, and further connects the storage part **52** and the integration processing part **53** to each other. The input and output control part **51** is connected to the ink head control part **21** and the height adjustment mechanism **26** of the ink supply device **1***b*.

The input and output control part **51** as described above performs input and output processing of data between the respective parts connected to each other via the input and output control part **51**, performs determination processing, and controls the drive of the roller drive part **42**, the on-off valves **45***a*, **46***a*, and the unit moving mechanism **47** and the drive of the height adjustment mechanism **26** of the ink supply device **1***b*. As a result, the cleaning processing of the nozzle surface **20***a* by the cleaning unit **40** is performed. The cleaning processing of the nozzle surface **20***a* performed by the input and output control part **51** will be described in detail in the following head cleaning method.

[Storage Part **52**]

The storage part **52** stores various pieces of data for implementing the head cleaning method by the head cleaning device **1***c*. Such data are, for example, the history of head cleaning processing and speed setting data.

Among the pieces of data, the speed setting data is data for setting and adjusting the moving speed [vx] of each cleaning unit **40** and the rotation speed [vr] of each cleaning roller **41**. The rotation speed [vr] is the surface speed of the side circumferential surface of the cleaning roller **41**. The storage part **52** corresponds to data representing a change in the composition of the cleaning liquid [L] in the storage tank **44** as speed setting data, and stores the moving speed [vx] of the cleaning unit **40** and the rotation speed [vr] of the cleaning roller **41**. Here, the change in the composition of the cleaning liquid [L] is the change in the density of the ink [L**2**] in the cleaning liquid [L]. Such speed setting data is unique data for each combination of the cleaning liquid [L**1**] and the ink [L**2**] supplied from the supply pipe **45**, and is stored in the storage part **52** for each combination of the cleaning liquid [L**1**] and the ink [L**2**].

Tables 1 and 2 below show an example of the speed setting data stored in the storage part **52**. Table 1 is an example of the case where the surface tension of the ink [L**2**] is lower than the surface tension of the cleaning liquid [L**1**]. On the other hand, Table 2 is an example of the case where the surface tension of the ink [L**2**] is higher than the surface tension of the cleaning liquid [L**1**].

TABLE 1

SURFACE TENSION CLEANING LIQUID [L1]: 40 mN/m INK [L2]: 30 mN/m

NUMBER OF CLEANING [n]	PIECE	0	10	20	30	40	50	60	70	80	90	100	110
INK DENSITY [C] OF CLEANING LIQUID [L] IN STORAGE TANK	%	0	2	4	6	8	10	12	14	16	18	20	22
SURFACE TENSION [F] OF CLEANING LIQUID [L] IN STORAGE TANK	mN/m	40	39.8	39.6	39.4	39.2	39	38.8	38.6	38.4	38.2	38	37.8
MOVING SPEED [vx]	mm/sec	50	47	44	41	38	35	32	29	26	23	20	17
ROTATION SPEED [vr]	mm/sec	100	110	120	130	140	150	160	170	180	190	200	210
SPEED RATIO [vr/vx]	—	2.00	2.34	2.73	3.17	3.68	4.29	5.00	5.86	6.92	8.26	10.00	12.35

TABLE 2

SURFACE TENSION CLEANING LIQUID [L1]: 40 mN/m INK [L2]: 50 mN/m

NUMBER OF CLEANING [n]	PIECE	0	10	20	30	40	50	60	70	80	90	100	110	120
INK DENSITY [C] OF CLEANING LIQUID [L] IN STORAGE TANK	%	0	2	4	6	8	10	12	14	16	18	20	22	24
SURFACE TENSION [F] OF CLEANING LIQUID [L] IN STORAGE TANK	mN/m	40	40.2	40.4	40.6	40.8	41	41.2	41.4	41.6	41.8	42	42.2	42.4
MOVING SPEED [vx]	mm/sec	50	53	56	59	62	65	68	71	74	77	80	83	86
ROTATION SPEED [vr]	mm/sec	100	95	90	85	80	75	70	65	60	55	50	45	40
SPEED RATIO [vr/vx]	—	2.00	1.79	1.61	1.44	1.29	1.15	1.03	0.92	0.81	0.71	0.63	0.54	0.47

In the speed setting data shown in Tables 1 and 2, the number of cleaning [n] is the number of ink heads **22**B subjected to pressure purge among the ink heads **22** wiped by the cleaning roller **41**, and is an integrated value. The number of cleaning [n] is one of data representing a change in the composition of the cleaning liquid [L] in the storage tank **44**. That is, in the ink head **22**B subjected to the pressure purge, the ink [L**2**] is forcibly pushed out from each nozzle opening **22***a*. The pushed out ink [L**2**] is brought into the storage tank **44** from the cleaning roller **41**, and the density of the ink [L**2**] in the cleaning liquid [L] is increased.

As shown in Tables 1 and 2, the moving speed [vx] of the cleaning unit **40** and the rotation speed [vr] of the cleaning roller **41** are stored in the storage part **52** as data corresponding to the number of cleaning [n] as described above.

In the storage part **52**, the ink density [C] of the cleaning liquid [L] in the storage tank and the surface tension [F] of the cleaning liquid [L] in the storage tank may be stored as values corresponding to the number of cleaning [n]. Among these, the ink density [C] and the surface tension [F] are also one of pieces of data representing a change in the composition of the cleaning liquid [L] in the storage tank **44**.

Here, as shown in Table 1, when the surface tension of the ink [L**2**] is lower than the surface tension of the initial cleaning liquid [L**1**], as the ink [L**2**] in the cleaning liquid [L] increases along with the increase of the number of cleaning [n], the surface tension of the cleaning liquid [L] decreases. In this case, the moving speed [vx] is decreased according to the reduction of the surface tension due to the composition change of the cleaning liquid [L], and the rotation speed [vr] is increased. Then, the speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx] is increased. This is because, when the ink density [L**2**] of the cleaning liquid [L] increases and the surface tension decreases, the cleaning liquid [L] easily remains on the water-repellent nozzle surface **20***a*, and this is for preventing such remaining of the cleaning liquid [L].

That is, by decreasing the moving speed [vx] of the cleaning roller **41** relative to the nozzle surface **20***a*, the number of hole portions **401** of the cleaning roller **41** supplied per unit time to the nozzle surface **20***a* per unit area can be increased. As a result, the absorption power of the cleaning liquid [L] by the cleaning roller **41** can be increased.

Also by increasing the rotation speed [vr] of the cleaning roller **41**, the number of hole portions **401** of the cleaning roller **41** supplied per unit time to the nozzle surface **20***a* per unit area can be increased. As a result, the absorption power of the cleaning liquid [L] by the cleaning roller **41** can be increased.

Therefore, by increasing the speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx], the remaining [L'] of the cleaning liquid [L] whose surface tension has been reduced to the nozzle surface **20***a* can be prevented.

In the initial stage where the number of cleaning [n] is small, the moving speed [vx] is high, so that the sliding amount (sliding time and sliding area) of the cleaning roller **41** on the nozzle surface **20***a* can be suppressed. Also by the fact that the rotation speed [vr] of the cleaning roller **41** is small, the sliding amount (sliding time and sliding area) of the cleaning roller **41** on the nozzle surface **20***a* can be suppressed. Therefore, at the initial stage where the number of cleaning [n] is small, the speed ratio [vr/vx] is lowered to suppress the sliding amount (sliding time and sliding area) of the cleaning roller **41** on the nozzle surface **20***a* so that it is possible to prevent the water repellency of the nozzle surface **20***a* from being reduced and the wiping member **41***b* of the cleaning roller **41** from being deteriorated.

On the other hand, as shown in Table 2, when the surface tension of the ink [L**2**] is higher than the surface tension of the initial cleaning liquid [L**1**], as the ink [L**2**] in the cleaning liquid [L] increases along with the increase of the number of cleaning [n], the surface tension of the cleaning liquid [L] increases. In this case, the moving speed [vx] is increased according to the increase of the surface tension due to the composition change of the cleaning liquid [L], and the rotation speed [vr] is decreased. Then, the speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx] is decreased. This is because, when the ink density [L**2**] of the cleaning liquid [L] is increased and the surface tension is increased, the wettability of the cleaning liquid [L] to the water-repellent nozzle surface **20***a* is further reduced, and this is for preventing the deterioration due to sliding of the cleaning roller **41** with respect to the nozzle surface **20***a* more than necessary.

That is, by relatively increasing the moving speed [vx] of the cleaning roller **41** with respect to the nozzle surface **20***a*, the sliding amount (sliding time and sliding area) of the cleaning roller **41** to the nozzle surface **20***a* can be suppressed. As a result, it is possible to prevent reduction of the water repellency of the nozzle surface **20***a* and degradation of the wiping member **41***b* of the cleaning roller **41**.

Also by decreasing the rotation speed [vr] of the cleaning roller **41**, the sliding amount (sliding time and sliding area) of the cleaning roller **41** on the nozzle surface **20***a* can be suppressed. As a result, it is possible to prevent reduction of the water repellency of the nozzle surface **20***a* and degradation of the wiping member **41***b* of the cleaning roller **41**.

Therefore, by reducing the speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx], while the wiping performance of the cleaning liquid [L] from the water-repellent nozzle surface **20***a* by the cleaning roller **41** is maintained, the deterioration of the nozzle surface **20***a* and the cleaning roller **41** can be suppressed. The example shown in Table 2 is an example, and if the decrease of the speed ratio [vr/vx] along with the increase of the number of cleaning [n] is maintained, each of the moving speed [vx] and the rotation speed [vr] may have different values from each other.

It is assumed that the speed setting data as described above is a value derived from the result of a simulation or cleaning test performed in advance.

[Integration Processing Part **53**]

The integration processing part **53** performs integration processing of the number of cleaning [n] for each cleaning roller **41**. The integration processing part **53** performs the integration processing on the basis of the history of the head cleaning processing stored in the storage part **52** and the information from the ink head control part **21** provided in each head unit **20**. Here, as described above, among the ink heads **22** wiped by the cleaning roller **41**, the number of ink heads **22**B subjected to pressure purge by the ink supply device **1***b* is integrated for each cleaning roller **41**. The integration processing part **53** holds the integrated number of cleaning [n]. The integration processing part **53** as described above is a composition acquisition part that acquires a change in the composition of the cleaning liquid [L] in the storage tank **44** due to the mixing of the ink [L**2**] supplied from the nozzle surface **20***a* via the cleaning roller **41**.

(Head Cleaning Method of Image Forming Device)

FIG. **10** is a flowchart showing the procedure of the cleaning of the nozzle surface **20***a* by the head cleaning device **1***c* according to the first embodiment. The head cleaning method shown in this flowchart is realized by causing the cleaning control part **50** to execute the image forming program stored in the ROM or RAM by the CPU constituting the cleaning control part **50** described with reference to FIG. **9**. The head cleaning method of the image forming device performed by the cleaning control part **50** will be described below with reference to FIGS. **5** and **9** and, if necessary, other drawings in the order shown in the flowchart of FIG. **10**.

<Step S**1**>

In step S**1**, the input and output control part **51** determines whether the pressure purge has been performed. At this time, the input and output control part **51** determines whether the pressure purge of forcibly pushing out the ink [L2] in the nozzle is performed in the head unit **20** of the ink supply device **1***b* on the basis of the information from the ink head control part **21** of the ink supply device **1***b*. The process is repeated until it is determined that the processing has been performed (YES), and when it is determined that the processing has been performed (YES), the process proceeds to step S**2**.

<Step S**2**>

In step S**2**, the input and output control part **51** determines whether the replacement processing of the cleaning liquid [L] has been performed. At this time, the input and output control part **51** determines whether the replacement processing of the cleaning liquid [L] in the storage tank **44** has been performed after the previous cleaning processing on the basis of the head cleaning history stored in the storage part **52**. When it is determined that the processing has been performed (YES), the process proceeds to step S**3**. On the other hand, when it is determined that the processing has not been performed (NO), the process proceeds to step S**4**. Note that this determination is performed for each cleaning unit **40**, or in the case where replacement processing of cleaning liquid [L] is performed simultaneously for all the cleaning units **40**, the determination is performed commonly for all the cleaning units **40**.

<Step S**3**>

In step S**3**, the input and output control part **51** initializes all the numbers of cleaning [n] held in the integration processing part **53** to [n]=0. When the determination in step S**2** is performed for each cleaning unit **40**, only the number of cleaning [n] corresponding to the cleaning unit **40** determined as performed in step S**2** (YES) is initialized to [n]=0

<Step S**4**>

In step S**4**, the input and output control part **51** performs moving processing of the head unit **20** and the cleaning unit **40**. At this time, the input and output control part **51** first controls the height adjustment mechanism **26** of the ink supply device **1***b* to move each head unit **20** of the ink supply device **1***b* to the height at the time of head cleaning (see FIG. **2**). Next, the input and output control part **51** controls the unit moving mechanism **47** to move each cleaning unit **40** to an interval [d] between the nozzle surface **20***a* of each head unit **20** and the mounting surface **13***s* of the endless belt **13** to a predetermined state. At this time, the unit moving mechanism **47** brings the cleaning roller **41** into contact with the edge of the nozzle surface **20***a*.

<Step S**5**>

In step S**5**, the input and output control part **51** sets the cleaning speed. The cleaning speed set here is the moving speed [vx] of each cleaning unit **40** and the rotation speed [vr] of each cleaning roller **41**. The input and output control part **51** sets the cleaning speed on the basis of the number of cleaning [n] held in the integration processing part **53** and the speed setting data stored in the storage part **52**.

At this time, the input and output control part **51** extracts the moving speed [vx] of each cleaning unit **40** stored in the storage part **52** and the rotation speed [vr] of each cleaning roller **41** correspondingly to the number of cleaning [n] held in the integration processing part **53** for each cleaning unit **40**. The extracted value is set as the moving speed [vx] of each cleaning unit **40** and the rotation speed [vr] of each cleaning roller **41**.

For example, at the initial stage of cleaning, the speed setting part **54** refers to Tables 1 and 2 and sets the moving speed [vx] (=50 mm/sec) and the rotation speed [vr] (=100 mm/sec) extracted correspondingly to the number of cleaning [n]=0, as the moving speed [vx] of each cleaning unit **40** and the rotation speed [vr] of each cleaning roller **41**.

<Step S**6**>

In step S**6**, the input and output control part **51** starts the cleaning processing. At this time, the input and output control part **51** controls the roller drive part **42** to rotate each cleaning roller **41** at the rotation speed [vr] set in step S**5**. The input and output control part **51** controls the unit moving mechanism **47** to move each cleaning unit **40** at the moving speed [vx] set in step S**5**. As a result, the cleaning processing of wiping off the nozzle surface **20***a* of each head unit **20** by the wiping member **41***b* of each cleaning roller **41** is started.

<Step S**7**>

In step S**7**, the input and output control part **51** causes the integration processing part **53** to perform integration processing of the number of cleaning [n]. At this time, the integration processing part **53** performs processing of integrating the number of ink heads **22**B subjected to pressure purge among the ink heads **22** of the head unit **20** performing the cleaning on the basis of the information from the ink head control part **21** provided in each head unit **20**, and the moving speed [vx] of each cleaning unit **40** set in step S**5** as needed. The integration processing part **53** holds the integrated number of cleaning [n].

<Step S**8**>

In step S**8**, the input and output control part **51** adjusts the cleaning speed. At this time, first, the input and output control part **51** extracts the moving speed [vx] of each cleaning unit **40** stored in the storage part **52** and the rotation speed [vr] of each cleaning roller **41** correspondingly to the number of cleaning [n] held in the integration processing part **53**. Next, the input and output control part **51** controls the roller drive part **42** so that the rotation speed [vr] of each cleaning roller **41** is the extracted rotation speed [vr]. The input and output control part **51** controls the unit moving mechanism **47** so that the moving speed [vx] of each cleaning unit **40** is the extracted moving speed [vx].

<Step S**9**>

In step S**9**, the input and output control part **51** determines whether the cleaning processing is completed. At this time, when each cleaning unit **40** moves in a predetermined direction and reaches the opposite edge of the nozzle surface **20***a*, the input and output control part **51** determines that the cleaning processing is completed (YES), and the process proceeds to step S**10**. Steps S**7** and S**8** are repeated until it is determined that the cleaning processing is completed (YES).

<Step S**10**>

In step S**10**, the input and output control part **51** performs cleaning end processing. At this time, the input and output control part **51** first stops the rotation of each cleaning roller **41** and the movement of each cleaning unit **40**. Next, the input and output control part **51** controls the unit moving mechanism **47** to move each cleaning unit **40** to the retracted position at the time of image formation (see FIG. **1**). Next, the input and output control part **51** controls the height adjustment mechanism **26** of the ink supply device **1***b* to move each head unit **20** of the ink supply device **1***b* to the height at the time of image formation (see FIG. **1**).

<Step S11>

In step S11, the input and output control part **51** determines whether replacement of the cleaning liquid [L] is to be performed. At this time, the input and output control part **51** determines whether the cleaning liquid [L] in the storage tank **44** is to be replaced on the basis of the number of cleaning [n] stored in the integration processing part **53** and the speed setting data. For example, when the number of cleaning [n] stored in the integration processing part **53** is equal to or more than the preset number of cleaning [n], the input and output control part **51** determines that the cleaning liquid [L] in the storage tank **44** is to be replaced, and the process proceeds to step S12, and in other cases, the process proceeds to step S13.

For example, referring to Table 1, when the surface tension of the cleaning liquid [L] used in each cleaning unit **40** is 40 mN/m and the surface tension of the ink [L2] used in the corresponding head unit **20** is 30 mN/m, if the number of cleaning [n] stored in the integration processing part **53** is 110 or more, the input and output control part **51** determines that the cleaning liquid is to be replaced (YES). In this case, if the number of cleaning [n] stored in the integration processing part **53** is smaller than 110, the input and output control part **51** determines that the cleaning liquid is not to be replaced (NO).

Referring to Table 2, when the surface tension of the cleaning liquid [L] used in each cleaning unit **40** is 40 mN/m and the surface tension of the ink [L2] used in the corresponding head unit **20** is 50 mN/m, if the number of cleaning [n] stored in the integration processing part **53** is 120 or more, the input and output control part **51** determines that the cleaning liquid is to be replaced (YES). In this case, if the number of cleaning [n] stored in the integration processing part **53** is smaller than 120, the input and output control part **51** determines that the cleaning liquid is not to be replaced (NO).

<Step S12>

In step S12, the input and output control part **51** performs the cleaning liquid replacement processing. At this time, the input and output control part **51** first controls the on-off valve **46***a* provided in the drain pipe **46** of the storage tank **44** to discharge the cleaning liquid [L] from the storage tank **44**. Next, the input and output control part **51** controls the on-off valve **45***a* provided in the supply pipe **45** of the storage tank **44** to supply the cleaning liquid [L1] in the initial state to the storage tank **44**. As a result, the cleaning liquid [L1] in the initial state, which does not contain the ink [L2] as the cleaning liquid [L], is stored in the storage tank **44**.

The input and output control part **51** strengthens the pressing force of the throttle member **43** against the cleaning roller **41** before closing the on-off valve **46***a* of the drain pipe **46** as compared to that at the time of cleaning, and the cleaning liquid [L] containing the ink [L2] impregnated in the cleaning roller **41** is squeezed out from the cleaning roller **41**. This prevents the ink [L2] from being carried from the cleaning roller **41** into the cleaning liquid [L] after the cleaning liquid replacement.

<Step S13>

In step S13, the input and output control part **51** determines whether the series of processing is to be ended. In this case, when the power of the image forming device **1** is shut off, for example, the input and output control part **51** determines that the processing is to be ended (YES) and ends the series of processing. On the other hand, if the input and output control part **51** determines that the processing is not to be ended (NO), the process returns to step S1 and waits until the next pressurized purge is performed, and the subsequent steps are repeated.

Effect of First Embodiment

According to the first embodiment described above, the speed ratio [vr/vx] between the moving speed [vx] of the cleaning unit **40** and the rotation speed [vr] of each cleaning roller **41** is controlled on the basis of the number of cleaning [n] of the ink head **22**B on which the pressure purge has been performed, which represents the change in the composition of the cleaning liquid [L] in the storage tank **44**. As a result, even when the ink density [L2] of the cleaning liquid [L] in the storage tank **44** is increased and the surface tension is decreased, remaining of the cleaning liquid [L] on the nozzle surface **20***a* can be prevented by increasing the speed ratio [vr/vx]. In this case, deterioration of the nozzle surface **20***a* and the cleaning roller **41** can be prevented by keeping the speed ratio [vr/vx] low at the initial stage where the number of cleaning [n] is small.

As a result, regardless of the change in the composition of the cleaning liquid [L] in the storage tank **44**, the wiping performance of the nozzle surface **20***a* by the porous cleaning roller **41** that impregnates the cleaning liquid [L] can be stably maintained over a long period of time.

Second Embodiment

FIG. **11** is a configuration diagram of a head cleaning device **1***c*' according to a second embodiment. The head cleaning device **1***c*' of the second embodiment shown in this drawing is a modification of the head cleaning device **1***c* of the first embodiment, and has a configuration in which an ink density detection part **48** is added to a cleaning unit **40'**. Therefore, a part of the configuration of a cleaning control part **50'** has a different configuration from the configuration in the first embodiment. Accordingly, the configurations of the ink density detection part **48** and the cleaning control part **50'** will be described here, and redundant description of the same components as those of the first embodiment will be omitted.

<Head Cleaning Device **1***c*'>

Cleaning Unit **40'**

[Ink Density Detection Part **48**]

The ink density detection part **48** is a detector for detecting the ink density [C] of the cleaning liquid [L] stored in the storage tank **44**. The configuration of the ink density detection part **48** as described above is not limited as long as it is a device that can detect the density [C] of the ink [L], and for example, a device that detects the ink density [C] by an optical means is used as the ink density detection part **48**. The ink density detection part **48** as described above is a composition acquisition part that acquires a change in the composition of the cleaning liquid [L] in the storage tank **44** due to the mixing of the ink [L2] supplied from the nozzle surface **20***a* via the cleaning roller **41**.

—Cleaning Control Part **50'**—

FIG. **12** is a block diagram of the head cleaning device **1***c*' according to the second embodiment, and mainly shows the configuration of the cleaning control part **50'**. The cleaning control part **50'** controls the operation of each part of the cleaning unit **40'**, and is formed by a computer such as a microcomputer. The computer includes a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM).

The cleaning control part **50'** as described above includes an input and output control part **51'** and the storage part **52**.

Each of these parts has a function to be described next, and the CPU in the cleaning control part **50'** reads out and executes a program stored in the ROM to realize each function. Hereinafter, the details of each part constituting the cleaning control part **50'** will be described on the basis of FIG. **11** and FIG. **12** described above.

[Input and Output Control Part **51'**]

The input and output control part **51'** is connected to the roller drive part **42**, the on-off valves **45***a*, **46***a*, the unit moving mechanism **47**, and the ink density detection part **48** of each cleaning unit **40'**, and further connected to the storage part **52**. The input and output control part **51'** is connected to the ink head control part **21** and the height adjustment mechanism **26** of the ink supply device **1***b*.

The input and output control part **51'** as described above performs input and output processing of data between the respective parts connected to each other via the input and output control part **51'**, performs determination processing, and controls the drive of the roller drive part **42**, the on-off valves **45***a*, **46***a*, and the unit moving mechanism **47** and the height adjustment mechanism **26** of the ink supply device **1***b*. As a result, the cleaning processing of the nozzle surface **20***a* by the cleaning unit **40'** is performed. The cleaning processing of the nozzle surface **20***a* performed by the input and output control part **51'** will be described in detail in the head cleaning method below.

[Storage Part **52**]

As similar to the first embodiment, the storage part **52** stores the history of the head cleaning processing and the speed setting data as various pieces of data for performing the head cleaning method by the head cleaning device **1***c*'. Among the pieces of data, the speed setting data is different from that of the first embodiment.

It is essential that the storage part **52** stores the moving speed [vx] of the cleaning unit **40'** and the rotation speed [vr] of the cleaning roller **41** as speed setting data correspondingly to the ink density [C] in the cleaning liquid [L] in the storage tank **44** (see Tables 1 and 2). The ink density [C] in the cleaning liquid [L] in the storage tank **44** is data representing a change in the composition of the cleaning liquid [L] in the storage tank **44**. Such speed setting data is unique data for each combination of the cleaning liquid [L**1**] and the ink [L**2**] in the initial state, and is stored in the storage part **52** for each combination of the cleaning liquid [L**1**] and the ink [L**2**].

The storage part **52** may or may not store the number of cleaning [n] as data representing a change in the composition of the cleaning liquid [L] in the storage tank **44**.

(Head Cleaning Method of Image Forming Device)

FIG. **13** is a flowchart showing the procedure of the cleaning of the nozzle surface **20***a* by the head cleaning device **1***c*' according to the second embodiment. The head cleaning method according to the second embodiment shown in this flowchart is a modification of the head cleaning method according to the first embodiment, and the similar steps to those in the first embodiment are denoted by the same step numbers, and redundant description will be omitted.

<Step S**1**>

In step S**1**, the input and output control part **51'** determines whether the pressure purge has been performed, the process is repeated until it is determined that the pressure purge has been performed (YES), and when it is determined that the pressure purge has been performed (YES), the process proceeds to step S3'.

<Step S**3'**>

In step S**3'**, the input and output control part **51'** acquires the ink density [C] of the cleaning liquid [L] in the storage tank **44** from the ink density detection part **48**.

<Step S**4**>

In step S**4**, the input and output control part **51'** performs unit moving processing to move each cleaning unit **40'** to between the nozzle surface **20***a* of each head unit **20** and the mounting surface **13***s* of the endless belt **13** to a predetermined state.

<Step S**5'**>

In step S**5'**, the input and output control part **51'** sets the cleaning speed. The cleaning speed set here is the moving speed [vx] of each cleaning unit **40'** and the rotation speed [vr] of each cleaning roller **41**. The input and output control part **51'** sets the cleaning speed on the basis of the acquired ink density [C] and the speed setting data stored in the storage part **52**.

At this time, the input and output control part **51'** extracts the moving speed [vx] of each cleaning unit **40'** stored in the storage part **52** and the rotation speed [vr] of each cleaning roller **41** correspondingly to the acquired ink density [C] for each cleaning unit **40'**. The extracted value is set as the moving speed [vx] of each cleaning unit **40'** and the rotation speed [vr] of each cleaning roller **41**.

For example, at the initial stage of cleaning, the speed setting part **54** refers to Tables 1 and 2 and sets the moving speed [vx] (=50 mm/sec) and the rotation speed [vr] (=100 mm/sec) extracted correspondingly to the acquired ink density [C]=0, as the moving speed [vx] of each cleaning unit **40'** and the rotation speed [vr] of each cleaning roller **41**.

<Step S**6**>

In step S**6**, the input and output control part **51'** starts the cleaning processing. At this time, the input and output control part **51'** controls the roller drive part **42** to rotate each cleaning roller **41** at the rotation speed [vr] set in step S**5'**. The input and output control part **51'** controls the unit moving mechanism **47** to move each cleaning unit **40'** at the moving speed [vx] set in step S**5'**. As a result, the cleaning of wiping off the nozzle surface **20***a* of each head unit **20** by the wiping member **41***b* of each cleaning roller **41** is started.

<Step S**7'**>

In step S**7'**, the input and output control part **51'** acquires the ink density [C] of the cleaning liquid [L] in the storage tank **44** from the ink density detection part **48**.

<Step S**8'**>

In step S**8'**, the input and output control part **51'** adjusts the cleaning speed. At this time, first, the input and output control part **51'** extracts the moving speed [vx] of each cleaning unit **40'** stored in the storage part **52** and the rotation speed [vr] of each cleaning roller **41** correspondingly to the ink density [C] acquired in step S**7'**. Next, the input and output control part **51'** controls the roller drive part **42** so that the rotation speed [vr] of each cleaning roller **41** is the extracted rotation speed [vr]. The input and output control part **51'** controls the unit moving mechanism **47** so that the moving speed [vx] of each cleaning unit **40'** is the extracted moving speed [vx].

<Steps S**9** to S**13**>

The subsequent steps S**9** to S**13** are performed in a similar manner to the steps of the first embodiment.

Effect of Second Embodiment

Even in the configuration of the second embodiment as described above, the speed ratio [vr/vx] of the moving speed [vx] of the cleaning unit **40** and the rotation speed [vr] of each cleaning roller **41** are controlled on the basis of the ink density [C] that represents the change in the composition of the cleaning liquid [L] in the storage tank **44**, so that, as in the first embodiment, regardless of the change in the composition of the cleaning liquid [L] in the storage tank **44**, the wiping performance of the nozzle surface **20***a* by the porous cleaning roller **41** impregnated with the cleaning liquid [L] can be stably maintained over a long period of time.

<<Modification>>

FIG. **14** is a main part perspective view explaining a modification of a head cleaning device according to an embodiment. FIGS. **15**A and **15**B are main part sectional views explaining the modification of the head cleaning device according to an embodiment. FIG. **15**A corresponds to the cross section of the part A in FIG. **14**, and FIG. **15**B corresponds to the cross section of the part B in FIG. **14**. The modification shown in these drawings differs from the head cleaning device of the first embodiment and the second embodiment only in the configuration of the throttle member **43"** provided in contact with the cleaning roller **41**.

That is, the throttle member **43"** is provided in a state of being in pressure contact with the side circumferential surface of the cleaning roller **41** constituted by the wiping member **41***b*, and controls the amount of the cleaning liquid [L] impregnated in the wiping member **41***b*. The throttle member **43"** as described above is made of a material harder than the wiping member **41***b*, such as hard rubber or stainless steel.

In particular, the throttle member **43"** is formed by a part obtained by dividing a cylindrical member covering the side circumferential surface of the cleaning roller **41** in the axial direction, and is formed as a plate member curved along the circumferential direction of the side circumferential surface of the cleaning roller **41**.

The throttle member **43"** as described above is supported by a support member (not shown), and can adjust the pressing force on the cleaning roller **41**.

The throttle member **43"** is provided in pressure contact with the side circumferential surface of the cleaning roller **41** in a range from the lower side of the liquid surface of the cleaning liquid [L] to the upper side of the liquid surface on the upstream side of the position where the cleaning roller **41** is brought into pressure contact with the nozzle surface **20***a* in the rotation direction of the cleaning roller **41**.

The contact pressure of the throttle member **43"** with respect to the side circumferential surface of the cleaning roller **41** is stronger toward the upstream in the rotation direction of the cleaning roller **41** at the axial center of the cleaning roller **41**. On the other hand, at both axial ends of the cleaning roller **41**, it is assumed that the contact pressure is set to be high on average from the upstream side to the downstream side in the rotation direction of the cleaning roller **41**. The throttle member **43"** as described above can be formed such that the contact pressure with respect to each part of the cleaning roller **41** is adjusted by the thickness of the curved plate-like member. That is, in the throttle member **43"**, the plate thickness of the portion in contact with the lower side of the liquid surface S and the plate thickness of the portion in pressure contact with both axial ends of the cleaning roller **41** are thicker than the other portions, and the throttle member **43"** is arranged close to the rotation center of the cleaning roller **41**.

(Effect of Modification)

According to such a modification, the throttle member **43"** is brought into pressure contact with the cleaning roller **41** from the lower side to the upper side of the liquid surface S of the cleaning liquid [L], so that the cleaning liquid [L] impregnated in the hole portion **401** of the wiping member **41***b* of the cleaning roller **41** can be squeezed out from the hole portion **401** at an earlier stage. As a result, the distance between the nip portion of the nozzle surface **20***a* and the cleaning roller **41**, and the throttle member **43"** can be increased, and the wiping member **41***b* in a deformed state due to the contact of the throttle member **43"** can be fully restored to its original shape until the wiping member **41***b* reaches the nip portion.

Therefore, the throttle member **43"** can be brought into contact with the cleaning roller **41** with a further higher pressure to squeeze out the cleaning liquid [L], and the space inside the hole portion **401** reaching the nip portion between the nozzle surface **20***a* and the cleaning roller **41** can be expanded. As a result, it is possible to improve the wiping efficiency of the ink [L**2**] by the wiping member **41***b* on the nozzle surface **20***a*.

Moreover, the end point of the region where the throttle member **43"** contacts with the cleaning roller **41** is set above the liquid surface S of the cleaning liquid [L], and the contact pressure of the throttle member **43"** is set to large in the entire region from the lower side to the upper side of the liquid surface S for both axial ends of the cleaning roller **41**, so that the cleaning liquid [L] can be prevented from being impregnated again in the region where the cleaning liquid [L] is squeezed out due to the contact of the throttle member **43"**.

<<Another Modification>>

Another modification can be exemplified for the first embodiment and the second embodiment described above. As an example, in the first embodiment, for example, replacement of the cleaning liquid [L] is automatically replaced as described with reference to FIG. **10**, but in step S**11**, when the input and output control part **51** determines that the replacement of the cleaning liquid [L] is to be performed (YES), notification of a cleaning liquid replacement message may be made. In this case, the notification of the message is performed, for example, to an external device possessed by the maintenance manager of the image forming device **1** or a display part of the image forming device whose description is omitted here.

In the first embodiment, the cleaning roller **41** is moved in a predetermined direction with respect to the nozzle surface **20***a* on which the plurality of ink heads **22** are arranged to perform the cleaning. However, the head cleaning device **1***c* can also be similarly applied to a device having a purpose of cleaning of the nozzle surface **20***a* on which one ink head **22** is arranged. In this case, the number of times the cleaning by the cleaning roller **41** is repeated for one ink head **22** after the pressure purge is performed may be the number of cleaning [n].

Furthermore, in the first and second embodiments, the cleaning roller **41** is moved in the predetermined direction with respect to the nozzle surface **20***a*. However, the movement and moving speed [vx] of the cleaning roller **41** with respect to the nozzle surface **20***a* may be relative, and the head unit **20** having the nozzle surface **20***a* may be moved with respect to the rotated cleaning roller **41**, or both of them may be moved.

In addition, in the first and second embodiments, the cleaning unit **40** including the cleaning roller **41** is arranged for each of the plurality of head units **20**. However, one cleaning unit **40** may be provided for the plurality of head units **20**. Furthermore, the relative movement direction of one cleaning unit **40** with respect to the arrangement direction of the plurality of head units **20** is not limited as long as the cleaning roller **41** can wipe the nozzle surface **20***a*.

Although embodiments of the present invention have been described and illustrated in detail, the disclosed embodiments are made for purposes of illustration and example only and not limitation. The scope of the present invention should be interpreted by terms of the appended claims

What is claimed is:

1. A head cleaning device comprising:

a porous cleaning roller that is arranged with a cylindrical axis kept horizontal, rotates around the axis while a cylindrical side circumferential surface is in pressure contact with a nozzle surface of an ink head to clean the nozzle surface;

a storage tank that is provided to store a cleaning liquid and immerse a lower part of the cleaning roller in the cleaning liquid stored;

a unit moving mechanism that moves a cleaning unit including the storage tank and the cleaning roller in a direction perpendicular to the axis of the cleaning roller;

a hardware processor that controls a rotation speed [vr] of the cleaning roller and a moving speed [vx] of the storage tank and the cleaning unit; and

a composition acquisition part that acquires a change in composition of the cleaning liquid in the storage tank due to mixing of ink supplied from the nozzle surface through the cleaning roller,

wherein the hardware processor controls a speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx] based on a change in the composition of the cleaning liquid acquired by the composition acquisition part.

2. The head cleaning device according to claim **1**,

wherein the hardware processor controls the rotation speed [vr] of the cleaning roller and the moving speed [vx] of the cleaning unit so that the speed ratio [vr/vx] increases according to decrease in a surface tension of the cleaning liquid due to the change in the composition of the cleaning liquid.

3. The head cleaning device according to claim **1**,

wherein the hardware processor controls the rotation speed [vr] of the cleaning roller and the moving speed [vx] of the cleaning unit so that the speed ratio [vr/vx] decreases according to increase in a surface tension of the cleaning liquid due to the change in the composition of the cleaning liquid.

4. The head cleaning device according to claim **1**,

wherein the hardware processor integrates the number of cleaning [n] of the ink head by the cleaning roller as the composition acquisition part, and makes the number of cleaning [n] integrated by the hardware processor correspond to the change in the composition of the cleaning liquid.

5. The head cleaning device according to claim **4**,

wherein the hardware processor determines that the cleaning liquid in the storage tank is to be replaced when the number of cleaning [n] integrated by the hardware processor reaches a predetermined value.

6. The head cleaning device according to claim **1**,

wherein the cleaning unit includes an ink density detection part that detects an ink density of the cleaning liquid in the storage tank as the composition acquisition part, and

the hardware processor makes the ink density detected by the ink density detection part correspond to the change in the composition of the cleaning liquid.

7. The head cleaning device according to claim **6**,

wherein the hardware processor determines that the cleaning liquid in the storage tank is to be replaced when the ink density detected by the ink density detection part reaches a predetermined value.

8. The head cleaning device according to claim **1**,

wherein the cleaning unit includes a throttle member brought into pressure contact with the side circumferential surface of the cleaning roller, and

the throttle member is provided in pressure contact with the side circumferential surface of the cleaning roller in a range from a lower part of a liquid surface of the cleaning liquid to an upper part of the liquid surface on an upstream side of a position in which the cleaning roller is brought into pressure contact with the nozzle surface in a rotation direction of the cleaning roller.

9. The head cleaning device according to claim **8**,

wherein the throttle member is brought into pressure contact with the cleaning roller at a pressure stronger than a pressure on a downstream side at an axial center of the cleaning roller at both axial ends of the cleaning roller and an upstream side of the rotation direction of the cleaning roller.

10. The head cleaning device according to claim **9**,

wherein the throttle member is a plate-like member curved along an outer circumferential surface of the cleaning roller, and the pressure of the pressure contact is adjusted by a plate thickness.

11. An image forming device comprising: an ink supply device including an ink head; and a head cleaning device that cleans a nozzle surface of the ink head,

wherein the head cleaning device includes

a porous cleaning roller that is arranged with a cylindrical axis kept horizontal, rotates around the axis while a cylindrical side circumferential surface is in pressure contact with a nozzle surface of an ink head to clean the nozzle surface,

a storage tank that is provided to store a cleaning liquid and immerse a lower part of the cleaning roller in the cleaning liquid stored,

a unit moving mechanism that moves a cleaning unit including the storage tank and the cleaning roller in a direction perpendicular to the axis of the cleaning roller,

a hardware processor that controls a rotation speed [vr] of the cleaning roller and a moving speed [vx] of the cleaning unit, and

a composition acquisition part that acquires a change in composition of the cleaning liquid in the storage tank due to mixing of ink supplied from the nozzle surface through the cleaning roller, and

the hardware processor controls a speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx] based on a change in the composition of the cleaning liquid acquired by the composition acquisition part.

12. A head cleaning method of an image forming device that includes a head cleaning device including

a porous cleaning roller that is arranged with a cylindrical axis kept horizontal, rotates around the axis while a cylindrical side circumferential surface is in pressure contact with a nozzle surface of an ink head to clean the nozzle surface,

a storage tank that is provided to store a cleaning liquid and immerse a lower part of the cleaning roller in the cleaning liquid stored, a unit moving mechanism that moves a cleaning unit comprising the storage tank and the cleaning roller in a direction perpendicular to the axis of the cleaning roller;

a hardware processor that controls a rotation speed [vr] of the cleaning roller and a moving speed [vx] of the cleaning unit, and

a composition acquisition part that acquires a change in composition of the cleaning liquid in the storage tank due to mixing of ink supplied from the nozzle surface through the cleaning roller,

the nozzle surface of the ink head being cleaned by the cleaning roller, the head cleaning method comprising:

controlling a speed ratio [vr/vx] of the rotation speed [vr] to the moving speed [vx] by the hardware processor based on a change in the composition of the cleaning liquid acquired by the composition acquisition part.

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